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NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

**DETERMINANTS OF FIRST-TERM ATTRITION FOR
ENLISTED AND OFFICER SELECTED MARINE CORPS
RESERVISTS**

by

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March 2015

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**DETERMINANTS OF FIRST-TERM ATTRITION FOR ENLISTED AND
OFFICER SELECTED MARINE CORPS RESERVISTS**

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ABSTRACT

This study examines the factors that correlate with first-term attrition of enlisted Marines and officers in the Selected Marine Corps Reserve (SMCR). The data for this study were provided by Headquarters Marine Corps Manpower and Reserve Affairs for fiscal years 2001 through 2014. We create two separate multivariate models to identify the causes of attrition for both populations.

The enlisted personnel model used finds that rank and education have the greatest effect on the attrition behavior of enlisted Marines, while the Armed Forces Qualification Test scores and waiver have the least effect. For officers, rank has the greatest effect on the attrition probability, while age and unit type variables have the least effects. Numerous other variables under different categories were found to have significant effects on Marine SMCR attrition behavior.

Some variables have different effects on each population, such as marital status. This variable is associated with higher attrition rates for enlisted personnel, while it decreases the attrition probability of officers. Other variables in this category include Physical Fitness Test scores, unit type, and number of dependents.

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TABLE OF CONTENTS

I.	INTRODUCTION.....	1
A.	PURPOSE.....	1
B.	BACKGROUND	3
C.	MARINE CORPS RESERVE COMPONENT	4
1.	Marine Corps Reserve Organization	5
a.	<i>Ready Reserve</i>	<i>6</i>
b.	<i>Standby Reserve</i>	<i>8</i>
c.	<i>Retired Reserve.....</i>	<i>9</i>
2.	Accession to the RC	10
3.	Role of Reserves	13
D.	BENEFITS OF THE STUDY	16
E.	RESEARCH QUESTIONS.....	17
F.	ORGANIZATION OF THE STUDY.....	17
II.	LITERATURE REVIEW	19
A.	INTRODUCTION.....	19
B.	INDEPENDENT STUDIES	21
1.	Modeling Incremental Initial Active Duty Continuation Probabilities in the Selected Marine Corps Reserve	21
2.	United States Marine Corps Reserve First-Term Attrition Characteristics.....	22
3.	Patterns of Marine Corps Reserve Continuation Behavior Pre- and Post-9/11	24
4.	Forecasting Retention in the United States Marine Corps Reserve	25
C.	SUMMARY	26
III.	DATA, METHODOLOGY, AND VARIABLE DESCRIPTION.....	27
A.	DATA SOURCE.....	27
B.	DATA DESCRIPTION	27
C.	VARIABLE OVERVIEW.....	29
D.	DEPENDENT VARIABLE.....	33
E.	INDEPENDENT VARIABLES	34
1.	Demographic Variables	34
a.	<i>Gender</i>	<i>34</i>
b.	<i>Race</i>	<i>35</i>
c.	<i>Marital Status.....</i>	<i>36</i>
d.	<i>Dependents</i>	<i>37</i>
e.	<i>Age</i>	<i>38</i>
f.	<i>Education Level.....</i>	<i>39</i>
2.	Ability and Aptitude	39
a.	<i>AFQT Scores</i>	<i>39</i>
b.	<i>Physical Fitness Test (PFT)</i>	<i>41</i>

	<i>c. Proficiency and Conduct (Pro/Con) Marks</i>	<i>43</i>
	<i>d. Waivers</i>	<i>44</i>
3.	Military Characteristics	45
	<i>a. Rank.....</i>	<i>45</i>
	<i>b. Occupational Specialty</i>	<i>47</i>
4.	Geographic Characteristics.....	49
	<i>a. Hometown.....</i>	<i>49</i>
	<i>b. Unemployment Rate.....</i>	<i>52</i>
5.	Fiscal Year Cohorts	52
F.	DATA LIMITATIONS.....	54
G.	SUMMARY	54
IV.	DESCRIPTIVE STATISTICS.....	57
A.	DESCRIPTIVE STATISTICS.....	57
B.	COMPARISON OF THE RESULTS	57
	1. Demographics (Gender, Race, Marital Status, Dependents, Age, Education Level).....	57
	2. Ability and Aptitude (AFQT Score, PFT Scores, Pro/Con Marks, Waivers).....	60
	3. Military Characteristics (Rank, Occupational Specialty)	62
	4. Geographic Characteristics (Hometown, Unemployment Rate) ...	66
	5. Fiscal Year Cohort (2001–2008 for Officers and 2001–2010 for Officers)	68
C.	SUMMARY	70
V.	MULTIVARIATE ANALYSIS AND RESULTS	73
A.	MULTIVARIATE FRAMEWORK.....	73
B.	MODELS AND RESULTS	73
	1. Hypothesized Effects of Variables on Attrition	76
	2. Model for Enlisted Personnel.....	78
	<i>a. Introduction of the Model.....</i>	<i>78</i>
	<i>b. Results of the Model.....</i>	<i>80</i>
	3. Model for Officers.....	80
	<i>a. Introduction of the Model.....</i>	<i>80</i>
	<i>b. Results of the Model.....</i>	<i>82</i>
	4. Analysis of the Results	82
	<i>a. Effects of Demographics on Attrition</i>	<i>83</i>
	<i>b. Effects of Ability and Aptitude on Attrition</i>	<i>87</i>
	<i>c. Effects of Military Characteristics on Attrition</i>	<i>89</i>
	<i>d. Effects of Geographic Characteristics on Attrition</i>	<i>90</i>
	<i>e. Effects of Fiscal Year Cohorts on Attrition</i>	<i>91</i>
C.	SUMMARY	92
VI.	SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS	95
A.	SUMMARY	95
B.	CONCLUSIONS AND RECOMMENDATIONS.....	96

1.	What Factors are Correlated with First-Term Attrition for Reserve Enlisted Marines?.....	96
a.	Conclusion.....	96
b.	Recommendations	97
2.	What Factors are Correlated with First-Term Attrition for Marine Reserve Officers?.....	98
a.	Conclusion.....	98
b.	Recommendations	99
3.	How Do First-Term Attrition Factors Differ between Officers and Enlisted Personnel?	99
a.	Conclusions	99
b.	Recommendations	99
C.	FOR FUTURE WORK.....	100
D.	FOR TURKEY	101
APPENDIX A. SUMMARY STATISTICS FOR FULL SAMPLE, ATTRITTED AND NON-ATTRITTED OF ENLISTED AND OFFICER RESERVISTS.....		103
APPENDIX B. RESULTS OF THE ENLISTED PERSONNEL MODEL		109
APPENDIX C. RESULTS OF THE OFFICERS MODEL		111
LIST OF REFERENCES		115
INITIAL DISTRIBUTION LIST		119

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LIST OF FIGURES

Figure 1.	Components of the Marine Corps Reserve	5
Figure 2.	NPS Reserve Officer Accessions (FY04–FY12).....	11
Figure 3.	SelRes Activation Diagram between September 2001 and September 2009 ..	14
Figure 4.	NPS Continuation Behavior Graph.....	15
Figure 5.	Composition of Gender for Officers and Enlisted Personnel	35
Figure 6.	Composition of Race for Officers and Enlisted Personnel	36
Figure 7.	Composition of Marital Status for Officers and Enlisted Personnel.....	37
Figure 8.	Composition of Dependents Status for Officers and Enlisted Personnel	38
Figure 9.	Maximum, Minimum, and Mean Values of Age for Officers and Enlisted Personnel.....	38
Figure 10.	Composition of Education Level for Officers and Enlisted Personnel.....	39
Figure 11.	Maximum, Minimum, and Mean Values of AFQT Scores for Enlisted Personnel and Officers.....	41
Figure 12.	Composition of PFT Scores for Officers and Enlisted Personnel.....	42
Figure 13.	Maximum, Minimum, and Mean Values of Pro/Con Marks for Enlisted Personnel.....	44
Figure 14.	Composition of Waiver Status for Enlisted Personnel	45
Figure 15.	Composition of Rank for Enlisted Personnel.....	46
Figure 16.	Composition of Rank for Officers	47
Figure 17.	Composition of MOS for Officers and Enlisted Personnel	48
Figure 18.	Census Regions and Divisions of the United States	50
Figure 19.	Composition of Home of Record Region for Enlisted Personnel.....	51
Figure 20.	Composition of Home of Record Region for Officers.....	51
Figure 21.	Cohort Distribution for Enlisted Personnel.....	53
Figure 22.	Composition of Cohorts for Officers	53
Figure 23.	Demographics Percentages of Enlisted Personnel.....	58
Figure 24.	Demographics Percentages of Officers.....	58
Figure 25.	Ability and Aptitude Indicators Percentages of Enlisted Personnel	61
Figure 26.	Ability and Aptitude Indicators Percentages of Officers.....	61
Figure 27.	MOS Percentages of Enlisted Personnel.....	63
Figure 28.	MOS Percentages of Officers	63
Figure 29.	Rank Percentages of Enlisted Personnel.....	64
Figure 30.	Rank Percentages of Officers.....	64
Figure 31.	Home of Record Regions' Percentages of Enlisted Personnel	67
Figure 32.	Home of Record Regions' Percentages of Officers.....	67
Figure 33.	Cohort Percentages of Enlisted Personnel	69
Figure 34.	Cohort Percentages of Officers.....	69

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LIST OF TABLES

Table 1.	Number and Proportions of Each Component.....	6
Table 2.	Contract Types for Enlisted Personnel in the SMCR	12
Table 3.	Summary of Operations Made in Data Sets.....	28
Table 4.	Overview of Variables	30
Table 5.	Classification of the AFQT Scores	40
Table 6.	Classification of the PFT Scores.....	42
Table 7.	Independent Variables by Base and Regression Groups	74
Table 8.	Hypothesized Effects of Independent Variables.....	77
Table 9.	Comparison of Models for Enlisted Personnel	78
Table 10.	Comparison of Models for Officers.....	81

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LIST OF ACRONYMS AND ABBREVIATIONS

AC	Active Component
AD	Active Duty
AFQT	Armed Forces Qualification Test
AR	Active Reserve
ASL	Active Status List
BLS	Bureau of Labor Statistics
DMDC	Defense Manpower Data Center
FMCR	Fleet Marine Corps Reserve
FY	Fiscal Year
GWOT	Global War on Terrorism
IIADT	Incremental Initial Active Duty Training
IMA	Individual Mobilization Augmentee
IRR	Individual Ready Reserve
ISL	Inactive Status List
IUT	Inter-Unit Transfers
MARFORRES	Marine Forces Reserve
MCP-R	Meritorious Commissioning Program-Reserve
MCRAMM	<i>Marine Corps Reserve Administrative Management Manual</i>
MCT	Marine Combat Training
MDPSD	Mandatory Drill Participation Stop Date
MGIB-R	Montgomery GI Bill-Reserve
MOS	Military Occupational Specialty
MSO	Military Service Obligation
NPS	Non-Prior Service
OCC-R	Officer Candidate Course-Reserve
OCONUS	Outside the Continental United States
OIF	Operation Iraqi Freedom
PEBD	Pay Entry Base Date
PFT	Physical Fitness Test
Pro/Con	Proficiency and Conduct

PS	Prior Service
RC	Reserve Component
RECP	Reserve Enlisted Commissioning Program
ROEP	Reserve Optional Enlistment Program
SelRes	Selected Reserve
SMCR	Selected Marine Corps Reserve

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I. INTRODUCTION

This chapter begins with introducing the purpose of this study and presents background. Then, it provides information about the Marine Corps Reserve Component (RC) and describes the benefits of the study and research questions. Chapter I concludes with the organization of the study.

A. PURPOSE

The goal of this study is to determine the factors correlated with first-term attrition of enlisted Marines and officers in the Selected Marine Corps Reserve (SMCR). Moreover, the question of whether the same set of factors is related to the attrition of officers versus enlisted personnel is assessed. This research originates from issues related to Marine Corps readiness and increased costs caused by attrition. Attrition increases turnover rates which results in loss of experience. So, with a low degree of experience, units will be less effective in terms of readiness. The study provides insight to the factors contributing to attrition and provides practical steps that can be used to reduce first-term attrition. The results are intended to be used by policymakers to reduce personnel excesses and shortages that effect costs such as pay, health care, and training.

The SMCR is a portion of the RC and a primary focus of the thesis. The majority, or 77%, of the Selected Reserve (SelRes) is affiliated with the units in the SMCR.¹ This study also divides the data into different cohorts by the fiscal year to identify whether there is a difference in the attrition behavior of the Marine reservists in different years. Some disastrous events or other situations during a given fiscal year such as 9/11 or unfavorable economic conditions may affect the attrition rate in the SMCR. To assess and control for these unforeseen effects, this research makes use of cohort variables. Specifically the role of demographic factors like gender and race, educational and aptitude scores like Proficiency and Conduct (Pro/Con) marks, and Armed Forces

¹ Jonathan D. Price, "Effects of Activation on Selected Marine Corps Reserve Prior Service Enlisted Continuation Rates in the Post-9/11 Era" (master's thesis, Naval Postgraduate School, 2010), 1 and 6, http://calhoun.nps.edu/bitstream/handle/10945/5437/10Mar_Price.pdf?sequence=1.

Qualification Tests (AFQTs) are analyzed, among others. The effects of hometown region of Marines and unemployment rates are also examined.

The data about individual officers and enlisted personnel is provided by Headquarters Marine Corps Manpower and Reserve Affairs for the years 2001 through 2014. Data about home state unemployment rates received from the Bureau of Labor Statistics (BLS) for the years 2001 through 2014 are also included.

According to the findings of this research, being married or divorced and having above a high school level of education are related to higher attrition probabilities for the enlisted Marines in the demographics category. Similarly, having high scores for the Physical Fitness Test (PFT) and being in a combat unit increase the attrition probability. On the other hand, the following are found to decrease the attrition probability for enlisted personnel: having a dependent, older age, higher AFQT scores, possession of a waiver, higher rank, and unemployment. The magnitude of the coefficients suggests that rank and education have the greatest effect on the attrition behavior of enlisted Marines, while AFQT scores and waiver have the lowest effect.

For the officers, the results of the multivariate model suggest that having a dependent, having an education level above high school, and being in an aviation unit are the factors that increase the attrition probability. However, being married, being an older age, having 1st class PFT scores, having a higher rank, and being in a combat unit are found to decrease the attrition probability for the officers. For the officers, rank has the greatest effect on attrition probability, while age and unit type variables have the least effect.

The comparison of models suggests that some variables have different effects on each population. For example, being married is associated with higher attrition probabilities for the enlisted personnel while it decreases the attrition probability of officers. Higher PFT scores and being in a combat unit are other variables which have the opposite results for each population. Similarly, having a dependent decreases the attrition probability of the enlisted Marines while it has the opposite effect for the officers.

B. BACKGROUND

The threats that nations face today are volatile and unpredictable. This fact makes it imperative for countries to quickly increase the capacity and size of their militaries during times of conflict. On the other hand, because stringent budgets are allocated to these militaries, they cannot maintain the size of force that is required during times of conflict. Hence, it is essential that there be a flexible system that augments the services only when required. RC Marines serve this purpose well. Attracting recruits who meet Marine Corps standards and keeping them in the RC during their contracted period is important to maintain an effective RC.

After the start of the Global War on Terrorism (GWOT), the Marine Corps burden increased. This situation increased the importance of Reserves and maintaining the manpower needed by the RC. However, in 2007 and 2008, the Marine Corps failed to meet the SelRes end strength of 39,600 Marines.² According to Price, there are two possible causes for this failure. First was the “Grow the Force” initiative, which aims to increase the number of Marines to 202,000 for the Active Component (AC), and the second was the post-9/11-era activations.³

During this period, the first-term attrition for enlisted and officer reservists became a problem for the Marine Corps. The loss of personnel due to attrition means the resources invested in initial training are essentially lost. For instance, according to Lizarraga’s study, the attrition rate is 10% at the beginning of first-term. However, this rate increases to 45% at the Mandatory Drill Participation Stop Date (MDPSD).⁴ This is an important result considering the recent economic conditions and the budget cuts. For example, the Marine Corps spent \$123 million training Reserve Personnel, which is 28% higher than the initially planned budgeted for this purpose.⁵ Most of this cost is the result of the high attrition rate in the Marine Corps.

² Ibid., 1.

³ Ibid.

⁴ Joseph M. Lizarraga, “Patterns of Marine Corps Reserve Continuation Behavior: Pre- and Post-9/11” (master’s thesis, Naval Postgraduate School, 2011), 6, http://calhoun.nps.edu/public/bitstream/handle/10945/5778/11Mar_Lizarraga.pdf?sequence=1.

⁵ Ibid., 2.

Another result of the attrition problem for the Marine Corps is the negative effect of attrition on readiness in the AC. For example, the results of this study show that the SMCR loses 57% of its first-term officers and 44% of first-term enlisted personnel prior to their MDPSP, which mostly covers a six-year period for enlisted personnel and a four-year period for officers starting with their contracts. This is consistent with the findings in the literature. Lizarraga provides similar information on attrition. He states that average attrition rate for non-prior service (NPS) reservists in the SMCR is less than 50% during their six-year drilling period.⁶ Furthermore, according to the U.S. Marine Corps (USMC) Force Policy Letter 1-14 issued in 2013, “Less than 13% of SMCR enlisted Marines who reached their mandatory drill stop date during fiscal year (FY) 2013 remain in the SMCR today.”⁷ This rate has been relatively stable in past years. A certain attrition level is beneficial for the Marine Corps, because planners can keep the right Marines in the force while the others leave the system. However, it is important that the rate does not become high enough to affect the combat readiness of the RC. Hence, planners are strategizing to keep the right personnel in the Marine Corps and influence them to continue beyond their obligated drilling requirements. Considering the magnitude of the problem, if this research can identify the causes of attrition in the SMCR, valuable information can be given to planners that they can use to reduce the attrition rate and increase the combat readiness of the RC.

C. MARINE CORPS RESERVE COMPONENT

This section includes succinct and relevant information about the Marine Corps Reserve. By knowing the structure and organization of the RC, the problem of attrition and continuation decisions of the individuals in the units will be better understood. The focus of this thesis is the SMCR, therefore more detailed information will be provided for this portion of the RC.

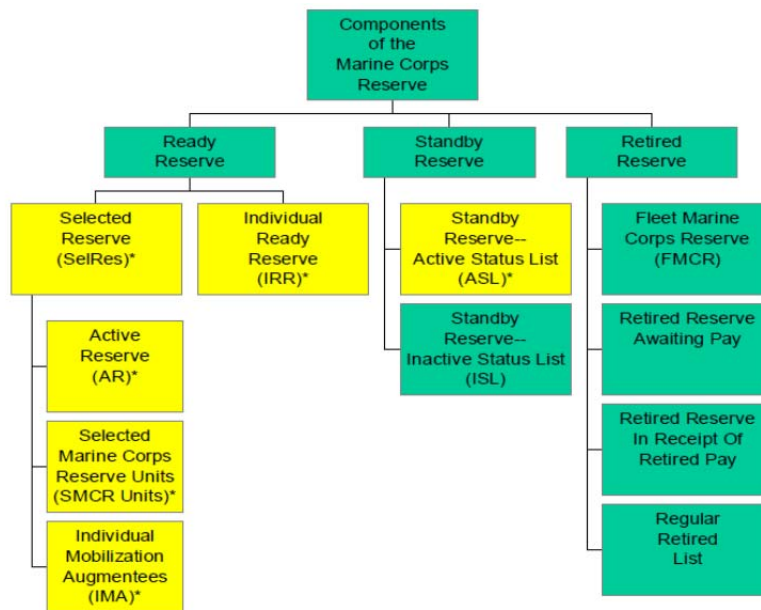
⁶ Ibid., 5.

⁷ United States Marine Corps, *Fiscal Year 2014 Marine Forces Reserve Retention Offensive*, Force Policy Letter 1-14, Washington, DC: U.S. Marine Corps, January 2014, 1, http://www.marforres.marines.mil/Portals/116/Docs/G-1/Adjutant/Directives/Policy_Letters/FPL%201-14%20-%20FISCAL%20YEAR%202014%20MARINE%20FORCES%20RESERVE%20RETENTION%20OFFENSIVE.pdf.

According to the *Marine Corps Reserve Administrative Management Manual (MCRAMM)*, the RC is an indispensable part of the Marine Corps, and supports and augments the AC during war or national emergency.⁸ The mission of the RC is “to augment and reinforce the AC with trained units and qualified individuals in a time of war or national emergency, and at such other times as national security may require.”⁹ Detailed information about the RC can be found in the *MCRAMM*.

1. Marine Corps Reserve Organization

The general structure of the Marine Corps RC is shown in Figure 1. RC consists of three subunits: Ready Reserve, Standby Reserve, and Retired Reserve. We describe these units in the forthcoming subheadings.



Note: Components highlighted in yellow (*) are elements of the RASL.

Figure 1. Components of the Marine Corps Reserve¹⁰

⁸ United States Marine Corps, *Marine Corps Reserve Administrative Management Manual (Short Title: MCRAMM)*, Marine Corps Order 1001R.1K, March 2009, 3, <http://www.marines.mil/Portals/59/Publications/MCO%201001R.1K.pdf>.

⁹ Ibid., 1–2.

¹⁰ Ibid., 1–6.

a. Ready Reserve

The Ready Reserve is composed of two units: SelRes and the Individual Ready Reserve (IRR). SelRes also consists of Active Reserve (AR), SMCR units, and Individual Mobilization Augmentees (IMAs). The number and proportions of each component in 2012 are shown in Table 1.

Table 1. Number and Proportions of Each Component¹¹

	Enlisted	Officer	Total
SelRes			
AR	1,854 2%	340 5%	2,194 2%
SMCR	32,793 35%	1,834 30%	34,627 34%
IMA	1,390 1%	1,691 27%	3,081 3%
Subtotal for Selected Reserve	36,037 38%	3,865 62%	39,902 40%
IRR	58,447 62%	2,321 38%	60,768 60%
Total	94,484 100%	6,186 100%	100,670 100%

The units and individuals in the Ready Reserve are those that will serve immediate active duty (AD) in case of war or national emergency.¹²

(1) Selected Reserve

The SelRes mainly includes the units and individuals that regularly train and drill to support its prospective wartime missions.¹³

¹¹ United States Marine Corps, *Department of the Navy Fiscal Year (FY) 2014 Budget Estimates*, April 2013, 13, http://www.finance.hq.navy.mil/FMB/14pres/RPMC_Book.pdf.

¹² United States Marine Corps, *Marine Corps Reserve Administrative Management Manual*, 1–2.

¹³ Price, “Effects of Activation,” 14.

AR includes the Marines who serve full time. The mission of AR is to support the Marine Corps Reserve to maintain its peace and wartime missions. The support includes administration, organization, recruiting, instruction, training, and retention of the reservists in the Marine Corps Reserve.¹⁴

The SMCR is the most important component of the Ready Reserve. Enlisted personnel and officers in the SMCR are obligated to serve under specific contracts which will be described in later sections. Marine reservists conduct their monthly drills and annual trainings in the SMCR units regularly. Drills are two days (generally one weekend) per month and 14 days of annual training. Non-participation or unsatisfactory participation in these drills may result in the removal of the service member from the RC or involuntary transfer to the Inactive Status List (ISL) in the Standby Reserve for officers who completed their Military Service Obligation (MSO).¹⁵ The SMCR consists of the 4th Marine Division (4th MarDiv), 4th Marine Logistics Group (4th MLG), 4th Marine Aircraft Wing (4th MAW), and force-level units of Marine Forces Reserve (MARFORRES).¹⁶ Because Marines drill regularly only in the SMCR and because the SMCR is the most important and active portion of the RC, most research related to Marine Reserves, including this thesis, use the SMCR as their population group.

IMAs are individual reservists who serve in a full-time capacity and are preassigned to an AC unit to support the Marine Corps during mobilization.¹⁷ These Marines also receive training like SMCR units one weekend per month.¹⁸ But unlike the SMCR, these individuals perform only 12 days of annual training. IMA can be activated under the authority of the Deputy Commandant Plans, Policies and Operations as

¹⁴ United States Marine Corps, *Marine Corps Reserve Administrative Management Manual*, 1–3.

¹⁵ Price, “Effects of Activation,” 19.

¹⁶ United States Marine Corps, *Marine Corps Reserve Administrative Management Manual*, 1–2.

¹⁷ Ibid., 1–2.

¹⁸ Ibid., 5–3.

individuals, rather than units like in the SMCR.¹⁹ Generally the contracts of the IMA are short term (e.g., one year).²⁰

(2) Individual Ready Reserve

The IRR is the largest portion of the Ready Reserve and is a Marine manpower pool that includes reservists who have had training and previously served either in the SelRes or in the AC.²¹ For example, most enlisted personnel in the AC sign a 4x4-year contract, while in the RC they sign a 6x2-year contract. After they serve the first term of their contracts in the AC and SMCR consecutively, the remaining 4- and 2-year periods are fulfilled in the IRR.²² Hence, the IRR is the primary unit for Prior Service (PS) Marines for recruiting.²³ These individuals are primarily available for mobilization. IRR includes the reservists who have not completed their MSO or who have completed their MSO but remain in the IRR by voluntary agreement. It is also possible to be transferred to IRR by authorization without completing the MSO. Reservists in the IRR do not get voluntary or involuntary training and are required to muster once per year to meet the screening requirements.²⁴ This is the main difference between individuals in the IMA and IRR.

b. Standby Reserve

The Standby Reserve includes Marine reservists who are unable to meet the requirements of the Ready Reserve but who want to keep their affiliation with the RC. These individuals may have contractual obligations or may be the officers who “failed to resign their commission.”²⁵ The Standby Reserve includes two subunits: Standby Reserve-Active Status List (ASL) and Standby Reserve-Inactive Status List (ISL).

¹⁹ Price, “Effects of Activation,” 14.

²⁰ Philip R. Herschelman, “United States Marine Corps Reserve First Term Attrition Characteristics” (master’s thesis, Naval Postgraduate School, 2012), 3, http://calhoun.nps.edu/bitstream/handle/10945/6807/12Mar_Herschelman.pdf?sequence=1.

²¹ United States Marine Corps, *Marine Corps Reserve Administrative Management Manual*, 1–3.

²² Herschelman, “United States Marine Corps Reserve,” 3.

²³ Price, “Effects of Activation,” 13.

²⁴ United States Marine Corps, *Marine Corps Reserve Administrative Management Manual*, 6–4.

²⁵ *Ibid.*, 1–3.

Although these individuals are not part of RC units and they are not required to train, they may still be mobilized to meet the manpower requirements of the AC.

(1) Standby Reserve-Active Status List²⁶

The individuals in this category are considered to be in active status. Although they are eligible for promotion and participate in trainings, they do not receive payment or allowances. The reason for them to drill is only for retirement point credits. In case of national emergency or war and if the Secretary of Defense approves, the Secretary of the Navy can order them to active duty. This active duty status would only be ordered when there are not enough qualified Ready Reserve personnel to meet mission requirements.

(2) Standby Reserve-Inactive Status List²⁷

This category includes Reserve Marines who are not eligible for promotion, payment, or retirement credit and cannot participate in Reserve trainings. Though the Reserves in the ASL can be considered for active duty in certain circumstances, individuals in the ISL do not have such a role. Currently, the ISL includes officers who completed their MSO and failed to meet participation prerequisites to stay in the active status but who want to keep the Reserve affiliation.²⁸ The Standby Reserve is not relevant to the focus of this thesis.

c. Retired Reserve

The Retired Reserve includes four subunits: Fleet Marine Corps Reserve (FMCR), Retired Reserve Awaiting Pay, Retired Reserve in Receipt of a Pay, and Regular Retired List. The Retired Reserve includes Reserve Marines who requested retirement and who were approved.²⁹ Like Standby Reserve, Retired Reserve is also not relevant to the scope of this thesis.

²⁶ Ibid.

²⁷ Ibid.

²⁸ Price, "Effects of Activation," 16.

²⁹ United States Marine Corps, *Marine Corps Reserve Administrative Management Manual*, 1–4.

2. Accession to the RC

Most of the Marine officers in the AC chose 4x4-year contracts.³⁰ The first four-year period means active service in the AC. The remaining four years means MSO, and this period is served in the RC, specifically in the SelRes or in the IRR. These officers are the primary source of officers for the RC.³¹ Though this is the major source of officers for the RC, these officers are senior in grade and this situation creates the lack of junior officers.³²

To address this issue, the Marine Corps employs three Reserve Junior Officer Accession Programs. These programs are Meritorious Commissioning Program-Reserve (MCP-R), which is available to enlisted personnel; Reserve Enlisted Commissioning Program (RECP), which is available to enlisted SMCRs; and Officer Candidate Course-Reserve (OCC-R), which is available for civilians and enlisted personnel of other services and which is the second most common source of SMCR officers. The NPS Reserve Officer accessions by programs from 2004 to 2012 are shown in Figure 2.³³ As shown in the figure, most of the accessions are from OCC-R, while the accessions from other programs are very limited. Officers serving under these programs are contracted with an eight-year MSO. The first four years are served in the SMCR and the last four years are served in the IRR.

³⁰ Philip R. Herschelman, "United States Marine Corps Reserve," 1.

³¹ United States Marine Corps, *Marine Corps Reserve Administrative Management Manual*, 2–2.

³² Ibid., 2–9.

³³ Anthony D. Licari, "Developing a Markov Model for Forecasting End Strength of Selected Marine Corps Reserve (SMCR) Officers" (master's thesis, Naval Postgraduate School, 2013), 5, http://calhoun.nps.edu/bitstream/handle/10945/32856/13Mar_Licari_Anthony.pdf?sequence=1.

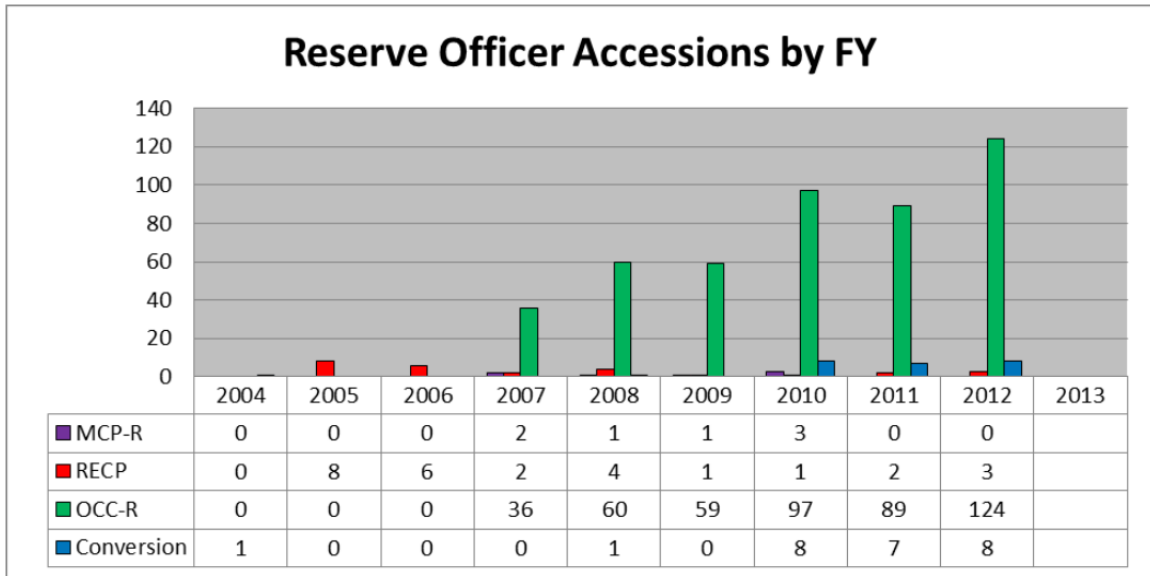


Figure 2. NPS Reserve Officer Accessions (FY04–FY12)

Contrary to officers, the majority of the enlisted personnel are NPS Marines. These enlisted Marines constitute 60% of all the RC enlisted personnel.³⁴ Besides NPS accessions, another source for the RC for enlisted personnel is the PS Marines. PS enlisted Marines join the RC after they serve a certain amount of time in the Marine Corps AD.

The most important difference between the NPS and PS personnel in the RC is that PS Marines do not have a service obligation. Contracts in the Ready Reserve only require Marines to serve in the Ready Reserve, and PS Marines can leave their SMCR units unless contracted specifically otherwise. Since the SMCR is the only part of the Ready Reserve which requires Marines to fulfill certain periods of drilling, this enables PS Marines to create more instability in the Ready Reserve.³⁵ But these Marines cannot get bonuses such as affiliation or reenlistment bonuses or Montgomery GI Bill-Reserve (MGIB-R). Also their unstable situation affects their retirement status.

³⁴ United States Marine Corps, *Marine Corps Reserve Administrative Management Manual*, 2–2.

³⁵ Price, “Effects of Activation,” 5.

There are two ways which a civilian can join the RC as an enlisted Marine.³⁶ First one is the “National Call to Service.” When a Marine completes the active duty period and does not wish to continue on this duty after that time, then the Marine completes the remaining period of the contract in the SelRes. The second way is the Reserve Optional Enlistment Program (ROEP). The contracts in the ROEP are eight-year contracts and consist of two parts. The first part is the three, four, five, or six-year periods. During these periods, Marines drill in the SMCR for designated times; the end of this period is called the Mandatory Drill Participation Stop Date (MDPSD). The remaining period of the MSO can be fulfilled in the IRR. The contract types and descriptions for each are shown in Table 2. For the PS enlisted personnel, there are also two options to join the RC. These options are the “Platoon Leaders Class” program and “PS Enlisted Personnel as SMCR New Accessions.”³⁷

Table 2. Contract Types for Enlisted Personnel in the SMCR³⁸

Contract Type	Contract Details
3X5	3 years drilling in the SMCR and 5 years remaining in the Ready Reserve
4X4	4 years drilling in the SMCR and 4 years remaining in the Ready Reserve
5X3	5 years drilling in the SMCR and 3 years remaining in the Ready Reserve
6X2	6 years drilling in the SMCR and 2 years remaining in the Ready Reserve

The majority of contracts for enlisted personnel in the SMCR, specifically, 97% of them,³⁹ are 6x2-year contracts, which is the reason most of the research conducted in the SMCR used 6x2-year contracted reservists as their research population. There are two possible reasons to warrant the popularity of the 6x2-year contracts. All Marines in the RC must sign a contract that requires them to serve in a SMCR unit satisfactorily at least six years to be eligible for the enlistment bonus.⁴⁰ Also a Marine reservist has to agree to

³⁶ United States Marine Corps, *Marine Corps Reserve Administrative Management Manual*, 2–6.

³⁷ Ibid., 2–7.

³⁸ Lizarraga, “Patterns of Marine Corps,” 16.

³⁹ Ibid., 16.

⁴⁰ United States Marine Corps, *Marine Corps Reserve Administrative Management Manual*, 2–3.

serve in the SMCR units for at least six years to receive the Montgomery GI Bill-Reserve (MGIB-R), which “is a non-contributory educational assistance benefit available to Marines.”⁴¹

Although relatively small in number when compared to 6x2-year contracts, some Marine reservists choose to join the SMCR with contracts requiring shorter drilling periods. But these contracts cause the RC to lose these reservists in their more experienced periods. Nevertheless, some Marine reservists in this group choose to extend their drilling periods in order to be eligible for the incentives, such as the MGIB-R.⁴²

3. Role of Reserves

As stated in the previous section, the role of the RC is to support and augment the AC with trained units and individuals in a time of war or national emergency. This is the main and first mission of the Marine Corps Reserve. However, there is another mission that is as important as the first mission: the social role of the RC. Once the Marine Corps activates the RC and employs the Reserve Units and individuals in a conflict or war, it makes a direct connection between American society and the conflicts via individual Reserves.⁴³ This makes the American people engaged in the events which are important for the national interests and keeps them aware of sensitive issues around the world.

Between 1973 and 1990, the RC was a “just in case” force under operational levels.⁴⁴ In 1990, with the First Gulf War, Reserve soldiers were activated for the first time since the Vietnam War,⁴⁵ and in the post-9/11 era, especially with Operation Iraqi Freedom (OIF), the RC started to be used extensively. The declaration of the GWOT and commencement of the pursuant operations in Iraq and Afghanistan created an

⁴¹ Ibid., 11–12.

⁴² Price, “Effects of Activation,” 22.

⁴³ Herschelman, “United States Marine Corps Reserve,” 5.

⁴⁴ Joseph F. Schumacher, “Forecasting Retention in the United States Marine Corps Reserve” (master’s thesis, Naval Postgraduate School, 2005), 2, http://edocs.nps.edu/npspubs/scholarly/theses/2005/Mar/05Mar_Schumacher.pdf.

⁴⁵ Christopher D. Luther, “Post-9/11 Field Grade Officer Requirements in The Marine Corps Reserve” (master’s thesis, Naval Postgraduate School, 2011), 3, http://calhoun.nps.edu/bitstream/handle/10945/5774/11Mar_Luther.pdf?sequence=1.

unprecedented burden on the shoulders of the RC in the last decade. For example, from September 2001 to September 2009, a total of 62,343 Marine reservists were activated. This means 17% of the SelRes was activated annually during this time frame, on average. This rate is considerably higher than 0.26%, which was the activation rate of the pre-9/11 period.⁴⁶ The largest activation occurred in April 2003 when 17,807 Marine reservists, which is 45% of SelRes, were activated.⁴⁷ The reason for this huge activation was the start of OIF. The activation of the SelRes Marines from September 2001 to September 2009 is shown in Figure 3. These Marines are the activated Reserves serving active duty to support the ongoing operations like OIF at the stated timeframes.⁴⁸

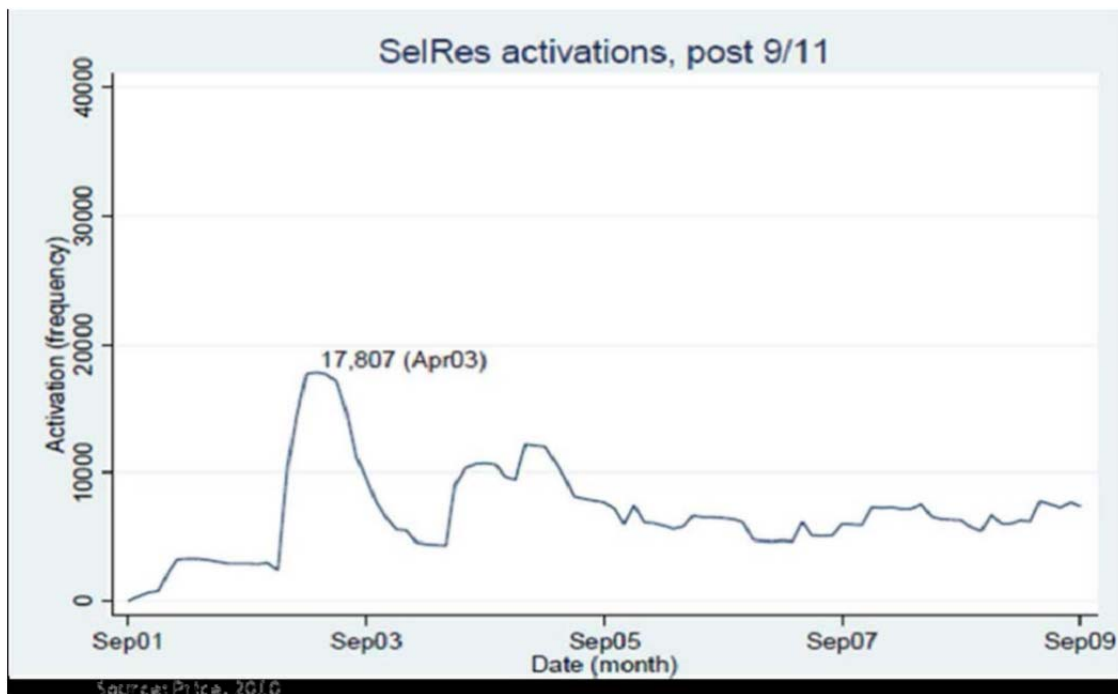


Figure 3. SelRes Activation Diagram between September 2001 and September 2009⁴⁹

⁴⁶ Lizarraga, "Patterns of Marine Marine Corps," 84.

⁴⁷ Herschelman, "United States Marine Corps Reserve," 5.

⁴⁸ Lizarraga, "Patterns of Marine Corps," 3.

⁴⁹ Price, "Effects of Activation," 7.

The increased employment of Reserve Units and individuals and other situations such as waste of resources or supporting the AC made the attrition problem an even greater issue than before. Especially in the last decade, events have affected the attrition and continuation decisions and behaviors of the Marine reservists. Figure 4, which is adapted from the research of Lizarraga, depicts attrition behavior of the enlisted personnel under 6x2-year contracts for the post-9/11 period.

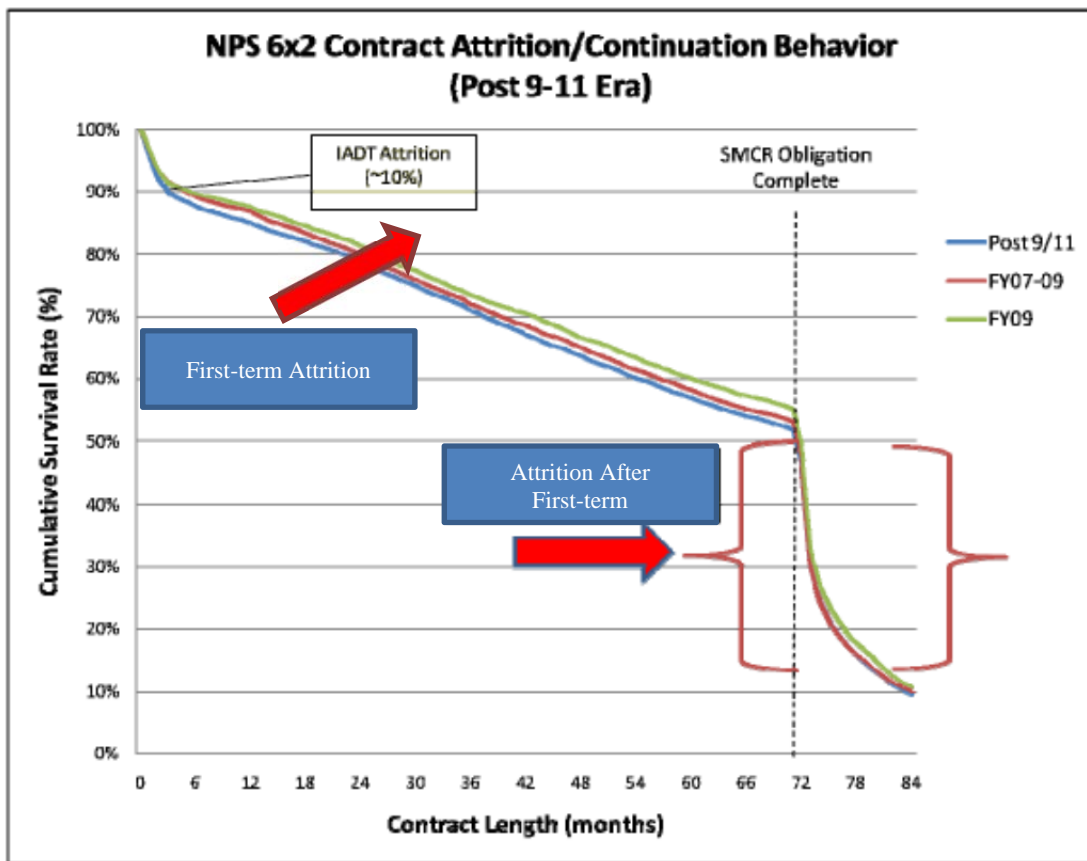


Figure 4. NPS Continuation Behavior Graph⁵⁰

The first-term (first six years) attrition rate for the enlisted personnel who are contracted with 6x2-year contracts is 45–48% on average, as shown in Figure 4. Interestingly, the 12-month continuation rate for the Marines who reached their MDPSD is less than 20%. This situation results in 10% of Marine reservists remaining to serve in

⁵⁰ Lizarraga, "Patterns of Marine Corps," 6.

the SMCR after seven years.⁵¹ This serious problem does not allow the Marine Corps to keep trained and experienced personnel to support the AC and wastes valuable resources such as money and time in training new enlisted personnel and officers. Furthermore, it is harder in such a situation to keep high-ranking officers and noncommissioned officers to fill the desired positions. The goal of this thesis is to analyze the attrition behavior of the enlisted personnel and officers and determine the characteristics of attrition. The findings of this study will provide information to the Marine Corps to reduce the attrition rate by increasing the number of reservists who fulfill their contracted periods.

D. BENEFITS OF THE STUDY

There are only a few studies that examine the attrition behavior of the reservists. Most of the research focuses on the AC attrition and continuation behaviors of the Marines. Though there is limited research for the RC, the majority of it is focused on attrition rate differences between the pre- and post-9/11 periods. Besides, some studies research the subpopulations within the Marine Corps RC, such as Incremental Initial Active Duty Training (IIADT).⁵² Furthermore, these studies tend not to focus on the question of “What factors impact the attrition rate?” and tend not to provide a general picture of the causes of the attrition. For officers, the studies are even more limited, especially for the RC, with most of the research studying mixed populations, which include officers and enlisted personnel together, such as Schumacher’s study.⁵³ This fact renders it impossible to make conclusions about the attrition behavior and characteristics of the officers in the RC. This situation in literature creates a gap which this research intends to fill.

By addressing the determinants of first-term attrition for enlisted and officer Selected Marine Corps Reservists, the negative consequences of the attrition problem can be reduced or even removed. First of all, the Marine Corps will keep its enlisted

⁵¹ Herschelmann, “United States Marine Corps Reserve,” 7.

⁵² Alan C. Dinsdale, “Modeling Incremental Initial Active Duty Continuation Probabilities in the Selected Marine Corps Reserve” (master’s thesis, Naval Postgraduate School, 2014), http://calhoun.nps.edu/bitstream/handle/10945/41369/14Mar_Dinsdale_Alan.pdf?sequence=1.

⁵³ Schumacher, “Forecasting Retention.”

personnel and officers longer than before and will save money and time for training and orientating the new recruits. Second, by keeping more trained, more experienced, and more ready individuals, the RC will be better able to support the AC in its ongoing missions and operations. Third, the positions that remain unassigned due to a lack of senior officers and enlisted personnel because of attrition will be filled with qualified and suitable personnel. Fourth, because the Marine Corps will be better able to predict future end strength due to the low or desirable attrition, it will be able to employ manpower policies more accurately. The fifth result of this study will be to help the Marine Corps to set more accurate and attainable recruiting and accession goals based on more reliable data. This thesis's findings will help the Marine Corps RC to better understand the continuation and attrition behavior of the reservists in the RC.

E. RESEARCH QUESTIONS

1. What factors are correlated with first-term attrition for Reserve Enlisted Marines?
2. What factors are correlated with first-term attrition for Marine Reserve Officer?
3. How do first-term attrition factors differ between officers and enlisted personnel?

F. ORGANIZATION OF THE STUDY

Chapter I is the introduction chapter of this study. It identifies the attrition problem and explains the structure and role of the Marine Corps RC. Chapter II is the literature review. It summarizes the findings of the previous studies about the attrition/continuation behavior of the Marine Corps reservists and examines the important definitions used in this study. Chapter III reviews the data used to identify and explain the variables that will be used in the models and includes a brief discussion about the methodology. Chapter IV provides the descriptive statistics based on the data that will be used in the models and presents preliminary analysis. Chapter V introduces the models to predict the results, presents the validation of models, and discusses the results of the models. Chapter VI provides a summary, conclusions, and recommendations for further research.

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II. LITERATURE REVIEW

Chapter II begins with an introduction, presents the literature review and concludes with a summary section.

A. INTRODUCTION

Current literature about the attrition problem in the Marine Corps mostly focuses on the AC. But recently, there has been a trend to examine the attrition and retention behavior of Marines in the RC. Many researchers have tried to identify the effects of some important events, such as the 9/11 terrorist attacks or OIF. Also, most of the remaining research examines the attrition problems of the subpopulations within the RC, such as IIADT. This research primarily focuses on enlisted personnel. There is no study which identifies the attrition behavior of the officers in the RC alone or with enlisted personnel. It is also worthwhile to mention that almost all of this research is conducted by the graduate students of the Naval Postgraduate School.⁵⁴

The goal of this thesis is to identify the determinants of first-term attrition for enlisted and officer Selected Marine Corps Reservists. This chapter introduces the studies that are relevant to the attrition problem in the SMCR and identifies the unexplored areas which this thesis reveals. The aim of this literature review is to provide a theoretical basis to create multivariate models to describe and predict the causes of attrition for the officers and enlisted personnel in the SMCR.

At this point, it is important to distinguish and introduce some important definitions about the goal of this thesis. This study follows Lizarraga to describe these terms, starting with the term *attrition*. Attrition can be described as “the separation of service prior to the completion of agreed upon contracted terms of military service.”⁵⁵ However, defining attrition is a more complex issue due to the unique status of the RC. For example, there are various available contracts for enlisted personnel and officers in the SMCR. Although the MSO is fixed at eight years, the MDPSP may change from

⁵⁴ Dinsdale, “Modeling Incremental Initial,” 7.

⁵⁵ Lizarraga, “Patterns of Marine Corps,” 21.

three years to six years. The remaining period of the contract is much less obliging than the first term and can be fulfilled in other units of the RC. Similar to this complexity, initial trainings such as Marine Combat Training (MCT) and Military Occupational Specialty (MOS) School can be conducted at different times or incrementally, such as for those in the IIADT program. Also, the attrition for the RC cannot always be considered a loss for the Marine Corps. For example, a Marine reservist who is enrolled in an officer program is not be considered as a loss even though it is attrition for the SMCR. These differences and considerations must be kept in mind when analyzing and conducting attrition and retention studies in the SMCR and RC.⁵⁶

As opposed to attrition, *retention* is keeping the individuals in the service for another term. For example, if a Marine reservist completes his first term, and voluntarily chooses to remain in the SMCR for an additional period, this is called *retention*.⁵⁷ When a reservist completes the first-term drilling obligation, this reservist is free to leave the SMCR as long as he remains in the Ready Reserve. While in the SMCR, it is mandatory to participate in the regular monthly and annual trainings. However, at the end of the first term, if the Marine reservists choose not to stay in the SMCR and are transferred to IRR, they do not have to attend the trainings other than mustering once a year.

In the literature, retention and continuation are sometimes considered the same, but this is not the case. Although they are interrelated, contrary to retention studies which focus on whether the individual will remain at the end of the contracted period, continuation tries to predict whether those individuals who extended their contracts will remain in the service until the end of their new contracts.⁵⁸ It can be seen from this definition that continuation encompasses longer time periods. For example, if an enlisted Marine remains after the first six-year contract, this situation is described as *retention*. If this individual completes his second six-year contract, this six-year period for the second contract is described as the *continuation* period.

⁵⁶ Ibid., 21.

⁵⁷ Ibid., 22.

⁵⁸ Ibid., 32.

B. INDEPENDENT STUDIES

This thesis focuses on the studies that examine the attrition behaviors of the Marine reservists in the SMCR. Because retention and continuation are related to attrition, studies on these topics will also be analyzed in the literature review.

Attrition can be considered as two types: wasteful and acceptable.⁵⁹ Acceptable attrition happens when a Marine reservist leaves his/her unit in the SMCR or leaves the RC but the Marine Corps keeps that individual in other units or organizations.⁶⁰ For example, if a Marine Reserve Officer leaves the SMCR and joins the AC, or if an enlisted Marine Reservist leaves the Ready Reserve to enroll in an officer program, these losses are considered acceptable attrition. The following choices are also not considered losses: Inter-Unit Transfers (IUTs), the IMA program, and AR.⁶¹ Although these losses are attrition for the SMCR or the SelRes, they are kept in the Marine Corps anyway. On the contrary, wasteful attrition occurs when a Marine reservist is expelled from the Ready Reserve for disciplinary problems, such as unsatisfactory participation, or legal problems, such as being dismissed by the courts.⁶² Furthermore, leaving the SMCR or RC to join the other services in the military is considered wasteful attrition. Studies on this subject reveal that most attrition in the SMCR is caused by transfers to the IRR.⁶³ Because this thesis examines the attrition only for the SMCR and because the attrition, whether acceptable or wasteful, means personnel loss for those units, all attrition in the SMCR will be considered wasteful attrition for this thesis.

1. Modeling Incremental Initial Active Duty Continuation Probabilities in the Selected Marine Corps Reserve

The most recent study about attrition in the SMCR is Dinsdale's research.⁶⁴ He examines the continuation behavior of the participants of the IIADT program in the

⁵⁹ Dinsdale, "Modeling Incremental Initial," 8.

⁶⁰ Herschelman, "United States Marine Corps Reserve," 8.

⁶¹ Lizarraga, "Patterns of Marine Corps," 19.

⁶² Herschelman, "United States Marine Corps Reserve," 8.

⁶³ Lizarraga, "Patterns of Marine Corps," 19.

⁶⁴ Dinsdale, "Modeling Incremental Initial," 1.

SMCR for the years 2002 to 2012. The IIADT program allows high school graduates who are enrolled in a college to enlist and complete their recruit training in the summer between high school and college.⁶⁵ During the summer periods in college, enlistees attend trainings in their SMCR units. This program aims to attract qualified enlistees in the Marine Corps Reserve. In his research, Dinsdale analyzes the behaviors of Marines for 12, 24, 36, 48, 60, and 72 months of service completed by using logistic regression. Dinsdale finds that Marines who attend IIADT have a lower probability of continuation to 24, 36, and 48 months, while there is no statistically significant effect for continuation behavior for the remaining milestones. Furthermore, he finds that first class Physical Fitness Test (PFT) scores and AFQT scores have positive effects on the attrition probability. He also reveals that there is a decreasing trend of continuation rate for the Marines from FY02 to FY10.

One of the differences between Dinsdale's research and this research is that he examines mainly one subpopulation of the SMCR—affiliates of IIADT—and presents findings about it. However, this research considers the entire population and aims to provide findings for all of the Marines. Because of this, Dinsdale's findings mainly relate to the behaviors of the Marines who attended the IIADT program and give little information about the general behaviors of the Marines in the SMCR. Another difference between Dinsdale's research and our thesis is the aim. While Dinsdale researches the question of whether IIADT affiliates attrite more, our thesis investigates the reasons for attrition. Hence, Dinsdale does not place a heavy focus on the reasons for attrition.

2. United States Marine Corps Reserve First-Term Attrition Characteristics

In his thesis, Herschelman examines the attrition characteristics of the NPS enlisted Marines with a 6x2-year contract in SMCR between FY 1994 and FY 2005.⁶⁶ A probit model is employed in this research to predict the results. He also studies the effects

⁶⁵ United States Marine Corps, "Interim Policy and Procedures for the Marine Corps Reserve Incremental Initial Active Duty Training (IIADT) Program," December 2014, <http://www.marines.mil/News/Messages/MessagesDisplay/tabid/13286/Article/172673/interim-policy-and-procedures-for-the-marine-corps-reserve-incremental-initial.aspx>.

⁶⁶ Herschelman, "United States Marine Corps Reserve," v.

of deployment and unit composition on attrition. His main question is whether the 9/11 disaster affected the attrition behavior of the enlisted Marines in the SMCR. To answer this question he divides his data into three parts: the pre-9/11 cohort, the overlap 9/11 cohort, and the post-9/11 cohort. He uses two models to reach the results. The first model, which is called the restricted model, includes only enlisted Marines who are deployed outside of the continental United States (OCONUS). Because the first group includes very few people deployed to OCONUS, he uses a second model, which is called an unrestricted model, that includes every Marine in the data.

In his restricted model, Herschelman reveals that deploying to dangerous areas decreases the attrition probability. Also, in the unrestricted model, he finds that support of the GWOT is beneficial for retention. Other characteristics that increase the attrition probability include increase of age, being female, and being in the aviation MOS. Although the literature suggests that having at least one dependent increases attrition probability, Herschelman discovers the opposite in his research. Further, he finds that unemployment rate and higher Pro/Con scores decrease the attrition probability. However, other characteristics related to ability do not provide consistent and significant results. Similar to these inconsistent findings, regions also do not yield useful results excluding three exceptions. Out of the nine regions in the United States, which are consistent with the U.S. Census Bureau's divisions, only three regions produce significant results. The Western Midwest, South Atlantic, and Southeastern regions have higher attrition rates than the control region, which is the Northeast.

The first difference between our research and Herschelman's is that he divides his data into three groups—pre-9/11, overlap 9/11, and post-9/11 cohorts—and he tries to reveal whether the catastrophic event of 9/11 has any effects on the attrition. Our study only analyzes the Marines who join the SMCR after 9/11, specifically between FY01 and FY14. Also, this study analyzes the determinants of attrition rather than the effects of any event. Another difference between the two studies is that Herschelman mainly considers the effect of deployment and restricted one of his models to include only Marines who were deployed to OCONUS. This research does not restrict its data to any subgroup and includes as many Marines as possible. Lastly, Herschelman analyzes only enlisted

Marines in the SMCR while this study analyzes enlisted Marines and officers separately, and will have the ability to compare them with each other.

3. Patterns of Marine Corps Reserve Continuation Behavior Pre- and Post-9/11

Lizarraga examines the continuation behaviors of NPS enlisted reservists after the end of their MDPSDs using a probit model.⁶⁷ Specifically, he researches the effects of mobilization on continuation decisions of Marine Reservists beyond their MDPSDs. He argues that expectations of reservists have a great impact on their continuation rates and divides his data into three cohorts to assess the impact of expectations. Similar to Herschelman's division, these cohorts are pre-9/11 cohort, the overlap 9/11 cohort, and the post-9/11 cohort. He states that the first cohort includes reservists who did not expect to be mobilized and were not mobilized, the second cohort includes Marines who did not expect to be mobilized but were mobilized, and the reservists in the last cohort include people who expected to be mobilized and were mobilized.

Lizarraga finds that deployment affects the continuation probability. However, this effect diminishes in the overlap and post-9/11 cohorts. This fact gives credence to the idea that as the expectations are met and get clearer, the continuation probability decreases. He also discovers that length of the deployment is important. While the 1–6 month mobilization has a positive effect, 7–12 months of mobilization decreases the continuation probability. Being female, being married, and serving in the Marine Logistics Group are other factors which decrease the continuation probability. On the other hand, being black, having the rank of Senior Noncommissioned Officer, and having higher Pro/Con and PFT marks increase the likelihood of continuation. Also, being divorced and having dependents increase the continuation probability. But these findings are not consistent in all the models used in the research. Lastly, the Mid-Atlantic and New England regions are found to have lower continuation rates, while the Mid-Atlantic, South Atlantic, and South East Central Region have higher continuation rates. But this finding is also not consistent in all the models used in the research.

⁶⁷ Lizarraga, "Patterns of Marine Corps," v.

In contrast to Lizarraga, we researched the first-term attrition of Marines in the SMCR rather than their continuation behavior after completing their first terms, which takes six years. Also, we do not divide our data into different cohorts and only use the data of Marines who were enlisted after the 9/11 period. Lastly, we use the data of both enlisted personnel and officers and get their results separately rather than using only one of them.

4. Forecasting Retention in the United States Marine Corps Reserve

In his thesis, Schumacher analyzes the effects of mobilization and unemployment rate on SMCR officers' and enlisted personnel's "stay in or leave" decision by utilizing logistic regression.⁶⁸ The data he used encompasses the years 1988–1992 and 1996–2004, which is provided by the Defense Manpower Data Center (DMDC) and Bureau of Labor Statistics (BLS).

Schumacher's findings about mobilization show that being mobilized has a positive effect on the decision to stay in. However, if the length of the mobilization gets longer, the individual is less likely to stay in. These conclusions imply that multiple short mobilizations have a positive effect on retention. These findings are consistent with the logic of participating in the Reserve. If an individual is in the Marine Reserve, that means this person shows a desire to serve when required to do so. Furthermore, if this individual wanted to serve longer and on a full-time basis, this person would prefer the AC over the RC.

Schumacher's findings about unemployment rates show that lower unemployment rates at the end of the service in the home states of the reservists have a negative effect on retention. That is, if the Reservist believes that he can find a job in the civilian market, he is less likely to stay in.

One possible drawback of this study is the time range of the data. As mentioned previously, it spans the years 1988–1992 and 1996–2004. That is, this study provides insight into the situation at the time of pre- and post-Gulf War. However, the usage

⁶⁸ Schumacher, "Forecasting Retention," 20.

strategy of the RC has changed since 9/11 and the level of mobilization of Reserves has increased. That is why Schumacher's study may fail to reflect the current situation. In contrast to the data of Schumacher, the data in this study will include post-9/11 era.

C. SUMMARY

This chapter summarized the studies found to be relevant to the topic of this thesis. This review will provide a theoretical basis to better comprehend the variables that will be used and the models that aim to identify the attrition behaviors of the Marine reservists.

We use the probit regression model, since the dependent variable, which is attrition, is binary. However, these types of regressions are not only used in military or in attrition studies. There are many social science studies that use logistics regression, including economics, demographics, and sociology. For example, in their studies, Willging and Johnson analyze the factors that affect students' decisions to leave online master's degrees offered in the University of Illinois by utilizing logistic regression.⁶⁹ Their data includes the students who left the online program. They used age, gender, GPA, sub-groups of ethnicity, location of students, and sub-groups of occupation as dependent variables. According to the findings, females, international students, and students with higher GPAs are more likely to drop out; directors, managers, and coordinators are less likely to drop out; and age does not have any effect on students' decision.

Like most of the studies on attrition and continuation, the data are divided into different cohorts based on the fiscal year to reveal any differences in the attrition rate of the Marines in different years, if they exist. We determine the causes of attrition and the effects of each of these causes to help the Marine Corps fight with the attrition problem and alleviate the negative effects of attrition, as described in detail in Chapter I.

⁶⁹ Pedro A. Willging and Scott D. Johnson, "Factors that Influence Students' Decision to Dropout of Online Courses," *Journal of Asynchronous Learning Networks* 13, no. 3, accessed February 28, 2015, <http://files.eric.ed.gov/fulltext/EJ862360.pdf>.

III. DATA, METHODOLOGY, AND VARIABLE DESCRIPTION

This chapter represents information about the source and content of data that is used in the multivariate models to predict the determinants of first-term attrition for enlisted and officer selected Marine Corps reservists. It also describes the methodology to clean and code the data. Furthermore, this chapter explains the descriptions of variables and the effects of each variable on attrition in previous studies. Finally, the limitations of the data are discussed in the end of this chapter.

A. DATA SOURCE

The data about individual enlisted personnel and officers are provided by Headquarters Marine Corps, Manpower and Reserve Affairs, covering the years 2001 through 2014. Any personal identification information was eliminated before acquisition, and unique numbers are assigned to each individual to prevent confusion and enable longitudinal analysis. The data about home state unemployment rates were received from the BLS and also cover the years 2001 through 2014.

B. DATA DESCRIPTION

There are two separate individual level data sets: the first one contains the information about enlisted personnel, and the second one contains the information about officer Reservists. The original enlisted personnel data set consists of 121,942 individuals, and the officer data set includes 10,254 individuals. Each of the original data sets is panel data, which means that the two data sets consist of individuals who are observed during certain periods between 2001 and 2014. In that respect, each observation in our data sets gives a reservist's service record for a specific year. If a Marine reservist leaves, the record ends at that attrition year.

Because there is no variation within the individuals in the data, the panel data is converted into cross-sectional data, which means that there is only one record line for each individual. For this conversion, first-year information is used for sex, race,

education, AFQT score, and waiver variables, and last-year information is used for all other variables such as age, marital status, and rank variables.

Since this study is about first-term attrition, which lasts six years for enlisted personnel, and because the last year in our data sets is 2014, we dropped the observations whose Pay Entry Base Date (PEBD) is after 2008 for enlisted personnel. This operation resulted in dropping 76,956 individuals in the enlisted data set. However, the same approach was not followed for the officer data for reasons which are described in Chapter V. A summary of these operations made in the data sets is shown in Table 3.

Unemployment rate data is merged with officer and enlisted data sets. For this merge, the unemployment rate of the home state of the individuals at the time of attrition, if attritted, or MDPSD, if not attritted, is used. Thus, unemployment rate is added to officer/enlisted data sets as one column and, naturally, this operation did not make any change in the number of observations in the data sets.

Table 3. Summary of Operations Made in Data Sets

Operation	Officer Data Set		Enlisted Data Set	
	Number of Observations Dropped	Number of Observations Remained	Number of Observations Dropped	Number of Observations Remained
Original	-	10,254 100%	-	121,942 100%
Conversion to Cross Sectional	-	10,254 100%	-	121,942 100%
Deleting PEBD before 2001 and after 2008	-	-	76,952 63%	44,990 37%
Deleting the obs. who are not SMCR	4,844 47%	5,410 53%	2,970 3%	42,020 34%
Automatically dropped due to missing values	1,396 14%	4,014 39%	25,600 21%	16,420 13%

C. VARIABLE OVERVIEW

The variables represented in this part are cleaned and coded data which will be used in the multivariate models. An overview of each variable is shown in Table 4. The dependent variable is *attrition*. Independent variables are divided into five groups: demographics, ability and aptitude, military characteristics, geographic characteristics, and fiscal year cohort. Demographics consist of six sub-groups: gender, race, education, marital status, dependents, and age. Ability and aptitude consist of four sub-groups: AFQT Score, Pro/Con Marks, PFT scores, and waivers. Military characteristics consist of two sub-groups: pay grade and MOS category. Geographic characteristics consist of two sub-groups: hometown and unemployment rate. Fiscal year cohorts consist of the years between 2001 and 2010.

Table 4. Overview of Variables

Category	Variable Description	Variable Name	Variable Type	Range
DEPENDENT				
	Attritted in the first-term	attrition	Binary	1 = Attritted 0 = Otherwise
INDEPENDENT				
Demographics	Gender	female	Binary	1 = Female 0 = Otherwise
	Race	white	Binary	1 = White 0 = Otherwise
		non-white	Binary	1 = Other Race 0 = Otherwise
	Marital Status	married	Binary	1 = Married 0 = Otherwise
		divorced	Binary	1 = Divorced 0 = Otherwise
		single	Binary	1 = Single 0 = Otherwise
	Dependents	depend	Binary	1 = At least 1 Dependent 0 = Otherwise
	Age	age	Continuous	Min = 17/20 Max = 52/62
	Education	HS_grad	Binary	1 = HS Graduate 0 = Otherwise
		more_HS	Binary	1 = Higher than HS Diploma 0 = Otherwise
Ability and Aptitude	AFQT Scores	afqt	Continuous	Min = 11/99 Max = 52/99
	PFT Scores	pft_1st	Binary	1 = 1 st Class Score 0 = Otherwise
		pft_2nd	Binary	1 = 2 nd Class Score 0 = Otherwise
		pft_3rd	Binary	1 = 3 rd Class Score 0 = Otherwise
	Proficiency and Conduct Marks	pros	Continuous	Average Proficiency Marks
		cons	Continuous	Average Conduct Marks
	waivers	waiver	Binary	1 = If Waiver Exists

Category	Variable Description	Variable Name	Variable Type	Range
				0 = Otherwise
Military Characteristics	Rank	E2	Binary	1 = PFC and P 0 = Otherwise
		E3	Binary	1 = LCpL 0 = Otherwise
		E4	Binary	1 = Cpl. 0 = Otherwise
		E5	Binary	1 = Sgt. 0 = Otherwise
		E6	Binary	1 = SSgt and Higher 0 = Otherwise
		W2	Binary	1 = CWO2 0 = Otherwise
		W3	Binary	1 = CWO3 0 = Otherwise
		W4	Binary	1 = CWO4 0 = Otherwise
		W5	Binary	1 = CWO5 0 = Otherwise
		O1	Binary	1 = 2 nd Lt. 0 = Otherwise
		O2	Binary	1 = 1 st Lt. 0 = Otherwise
		O3	Binary	1 = Capt. 0 = Otherwise
		O4	Binary	1 = Maj. 0 = Otherwise
		O5	Binary	1 = Lt.Col. 0 = Otherwise
		O6	Binary	1 = Col. 0 = Otherwise
	Occupational Specialty	combat_mos	Binary	1 = If Combat 0 = Otherwise
		aviation_mos	Binary	1 = If Aviation 0 = Otherwise
		support_mos	Binary	1 = If Support 0 = Otherwise
Geographic Characteristics	Hometown			
	Midwest East IL, IN, MI, WI, OH	home_midwesteast	Binary	1 = If Related State 0 = Otherwise
	Midwest West MO, ND, NE, KS, SD, MN, IA	home_midwestwest	Binary	1 = If Related State 0 = Otherwise

Category	Variable Description	Variable Name	Variable Type	Range
	New England CT, MA, ME, NH, RI, VT	home_newengland	Binary	1 = If Related State 0 = Otherwise
	Mid Atlantic NJ, NY, PA	home_midatlantic	Binary	1 = If Related State 0 = Otherwise
	South Atlantic FL, GA, SC, NC, VA, WV, DC, MD, DE	home_southatlantic	Binary	1 = If Related State 0 = Otherwise
	South East KY, TN, MS, AL	home_southeast	Binary	1 = If Related State 0 = Otherwise
	South East Central OK, AR, TX, LA	home_southeastcent ral	Binary	1 = If Related State 0 = Otherwise
	West Mountain AZ, NM, NV, UT, ID, CO, MT, WY	home_westmountai n	Binary	1 = If Related State 0 = Otherwise
	West Pacific CA, HI, OR, WA, AK	home_westpacific	Binary	1 = If Related State 0 = Otherwise
	Unemployment Rate	unemp	Continuous	Hometown Unemployment Rate
Fiscal Year Cohorts		FY02	Binary	1 = If PEBD in Related year 0 = Otherwise
		FY03	Binary	1 = If PEBD in Related year 0 = Otherwise
		FY04	Binary	1 = If PEBD in Related year 0 = Otherwise
		FY05	Binary	1 = If PEBD in Related year 0 = Otherwise
		FY06	Binary	1 = If PEBD in Related year 0 = Otherwise
		FY07	Binary	1 = If PEBD in Related year 0 = Otherwise
		FY08	Binary	1 = If PEBD in

Category	Variable Description	Variable Name	Variable Type	Range
				Related year 0 = Otherwise
		FY09	Binary	1 = If PEBD in Related year 0 = Otherwise
		FY10	Binary	1 = If PEBD in Related year 0 = Otherwise

D. DEPENDENT VARIABLE

Attrition is an important problem for the Marine Corps Reserve and is affected by many factors which will be discussed in detail in the following chapters. As described in the previous section, attrition may either be acceptable, such as a transfer to AC, or wasteful, such as being expelled from the military for disciplinary reasons. But for the SMCR, both types of attrition represent losses for the units and are therefore considered wasteful attrition for the SMCR. To identify and determine the causes of attrition, the binary variable *attrition* is created in the multivariate models for this study. This variable takes the value of “1” if the Marine reservist has less than six observations for enlisted personnel and “0” otherwise. For the officers, the number of observations is four to decide whether the individual has left or not. The rationale behind this decision is the duration of the first-term contracts, which is six-year for the enlisted personnel and four-year for the officers. According to this description, the attrition rate for the officers and enlisted personnel are 57% and 44%, consecutively, in our data. However, these rates include measurement error. For example, if a Marine leaves the RC in 2002 after serving only one year and returns back again in 2005 and serves another five years, that individual should be considered as attritted. However, because total years served in the RC is six years, our model will not consider this individual as attritted. Also, because of the data constraint, it is not possible to define whether a Marine is a wasteful attrition or acceptable attrition. These shortcomings should be kept in mind when interpreting the results.

E. INDEPENDENT VARIABLES

This section presents the independent variables that are used in the multivariate models in this study.

1. Demographic Variables

When researching manpower-related topics, it is very important to control for and evaluate the effects of demographic characteristics because these factors have considerably high effects on the attrition decisions of personnel in the military. The factors that will be included under demographic characteristics are gender, race, marital status, dependents, age, and education level.

a. Gender

Gender category is included in this study to identify the effect of being male or female on the continuation decisions of the Marine Reservist. Findings in the literature suggest that females are more likely to attrite than males. For example, Lizarraga concludes that females are 4.7 percentage points less likely to continue.⁷⁰ Recent policies of the Marine Corps signify that females will assume more active roles in the Marine Corps and they will be assigned to combat unit positions.⁷¹ These facts make it more important to evaluate the effect of gender on the attrition probability. There is one binary variable in the multivariate models in this study to capture this effect: *female*. It takes the value of “1” if the individual has the relative gender and “0” otherwise. Figure 5 depicts the gender composition of the officers and enlisted personnel in the data separately.

⁷⁰ Lizarraga, “Patterns of Marine Corps,” 120.

⁷¹ Dinsdale, “Modeling Incremental Initial,” 19.

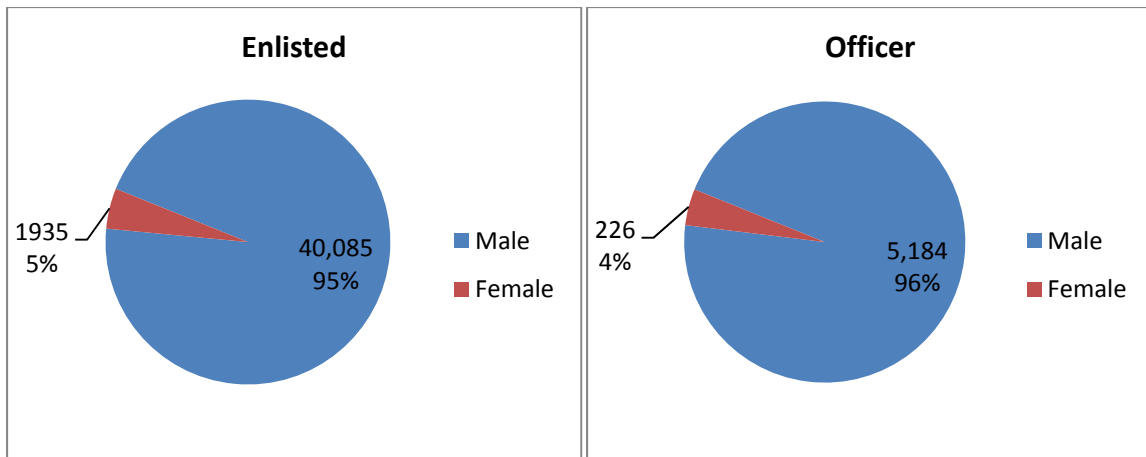


Figure 5. Composition of Gender for Officers and Enlisted Personnel

b. Race

This category is included in this study to capture the effect of racial characteristics on the attrition behavior of the Marine Reservists. Previous studies in the literature find that blacks are more likely to continue while Asians are more likely to attrit.⁷² Two binary variables are identified for racial classification: *white* and *non-white*. These variables take the value of “1” if the individual is in the related category and “0” otherwise. There are numerous missing values in the data for race category. Furthermore, many Marine Reservists have response of “chose not to answer” for this category, so these observations were considered as missing value for the data. These facts affect the predictive ability of the multivariate models in this study. Figure 6 presents the distribution of the officers and enlisted personnel separately in the data by their race category.

⁷² Lizarraga, “Patterns of Marine Corps,” 121.

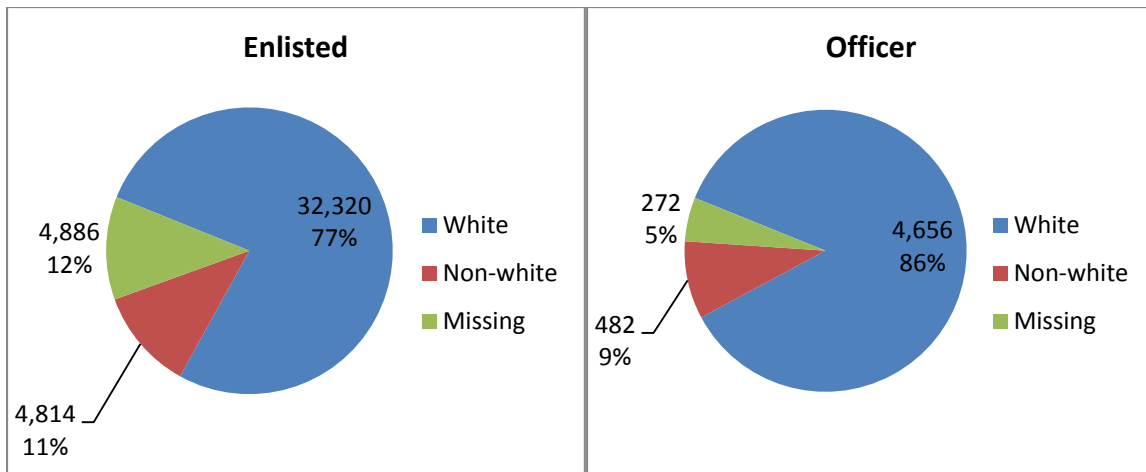


Figure 6. Composition of Race for Officers and Enlisted Personnel

c. *Marital Status*

Marital status variables are added to the multivariate models to capture the effect of being married, single, or divorced on the continuation decisions of the Marine reservists. Because problems and mental and emotional adversities of divorced individuals may be different than those who are married or single, another variable for divorced Marines is added to identify the different effects of this status on the attrition probability. Hence, there are three binary variables under this category: *single*, *married*, and *divorced*. But because the number of divorced individuals in the officer data set is too low, only the *married* and *single* variables are defined for the officers and the *married* variable is included in the model. These variables take the value of “1” if the individual is in the related category and “0” otherwise. Literature suggests that while the effect of being married is negative on attrition, being divorced has positive effects. For example, Lizarraga finds that individuals who are married are more likely to attrit but concludes that divorced individuals are 9.4 percentage points more likely to continue.⁷³ Figure 7 shows the marital status composition of the officers and enlisted personnel in the data.

⁷³ Ibid., 121.

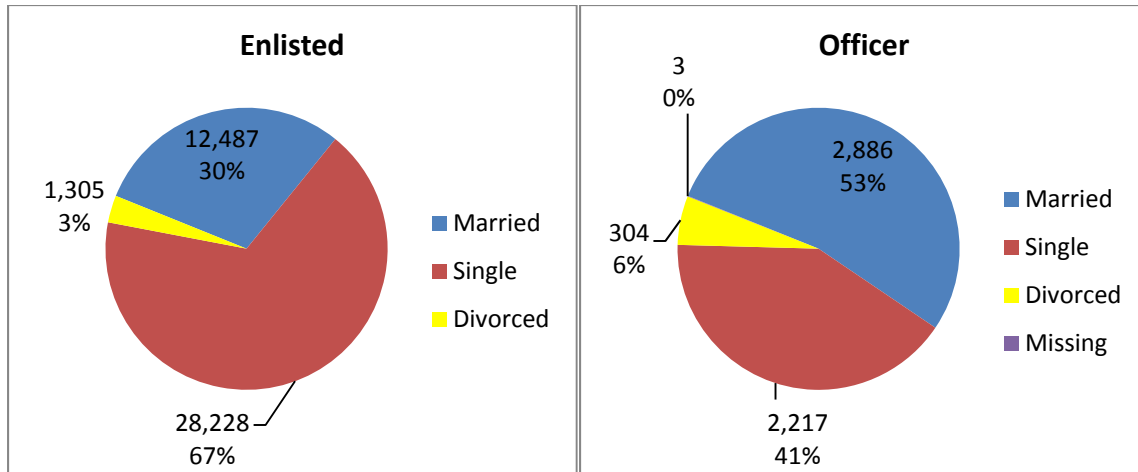


Figure 7. Composition of Marital Status for Officers and Enlisted Personnel

d. Dependents

According to the literature, dependents have a positive effect on the attrition probability. For example, Lizarraga⁷⁴ and Herschelman⁷⁵ conclude that having one or more dependents increases the continuation probability. This category does not include only children; it also includes other people such as spouses or elder relatives who need continuous care. To control for and assess the effects of dependents on the attrition probability, the variable *dependent* is defined in this study. This variable takes the value of “1” if the individual has any dependents and “0” otherwise. Figure 8 depicts the dependent information of the officers and enlisted personnel in the data.

⁷⁴ Ibid., 122.

⁷⁵ Herschelman, “United States Marine Corps Reserve,” 62.

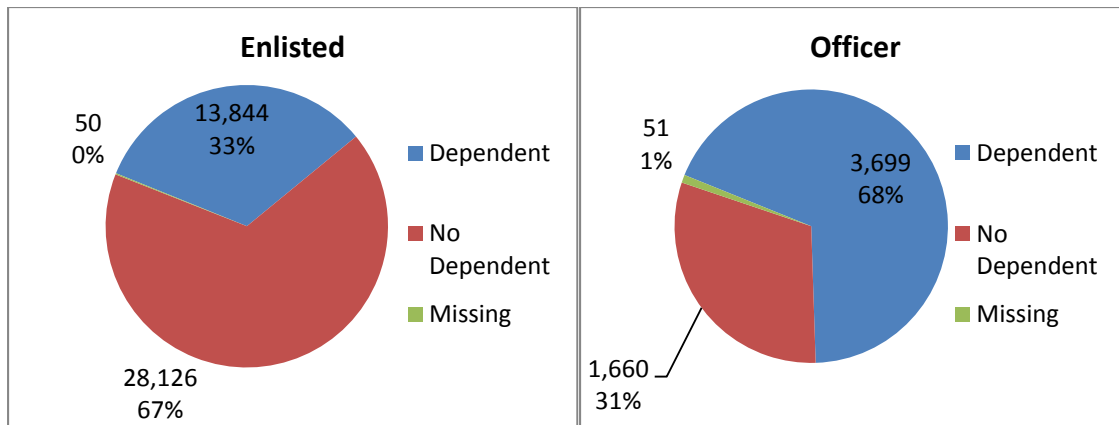


Figure 8. Composition of Dependents Status for Officers and Enlisted Personnel

e. Age

The variable *age* is included in the multivariate models to examine the effect of age on the continuation decisions of the individual Marines. Literature suggests that age has negative effects on the attrition probability, because as people mature, they have more chances to pursue better career options in the civilian sector.⁷⁶ *Age* is a continuous variable and takes the value of age of the individual Marine Reservists on their attrition date or MDPSP. Figure 9 provides maximum, minimum, and mean values of age variable for officers and enlisted personnel in the data separately.

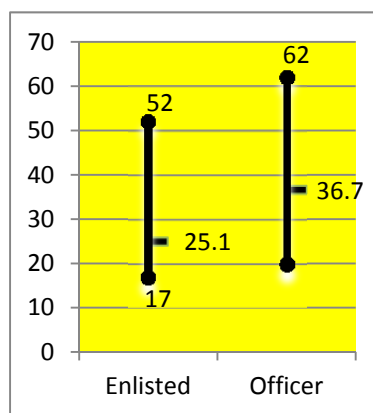


Figure 9. Maximum, Minimum, and Mean Values of Age for Officers and Enlisted Personnel

⁷⁶ Lizarraga, "Patterns of Marine Corps," 72.

f. Education Level

This variable is included in the models to assess the effects of education level of each Marine Reservist on the attrition probability. The education levels at the pay entry base date (PEBD) for each officer and enlisted personnel are taken into consideration in this category. Two sub-categories are identified to group the individuals in the data sets: high school and below high school graduate is the first category, and more than high school graduate is the second category. These categories are denoted with binary variables which are *HS_grad* and *more_HS*. They take the value of “1” if the individual is in the related education category and “0” otherwise. Figure 10 depicts the distribution of the officers and enlisted personnel by their education level separately.

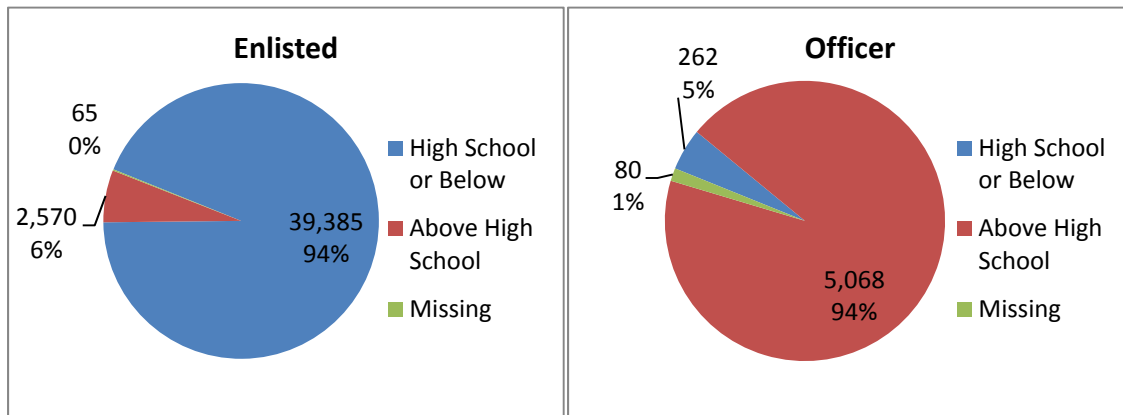


Figure 10. Composition of Education Level for Officers and Enlisted Personnel

2. Ability and Aptitude

Under this category, there are some variables which this study uses in the multivariate models to evaluate the ability, motivation, adaptability, and performance of each individual Marine. These variables are AFQT scores, PFT, Pro/Con Marks, and waivers.

a. AFQT Scores

AFQT is a standardized test which every officer and enlisted personnel has to take before admission to the U.S. military. This test evaluates the ability and aptitude of each

individual and is a significant proxy to assess those traits. The range of AFQT scores is between 0 and 99. It is possible that an individual who has a high score on the AFQT may be willing to stay in the military. However, it is also likely that this individual has abilities and knowledge which may be high in demand in the civilian economy and may want to leave the military to make use of his abilities. Literature suggests that higher AFQT scores increase the attrition probability. For example, Dinsdale finds in one of his models that high AFQT scores decrease the continuation probability.⁷⁷ To assess the effects of AFQT scores on the attrition behavior of the Marines in the SMCR, this research includes the AFQT as a proxy for ability and attitude. The AFQT scores are included in the models using the continuous variable *afqt*. AFQT scores are categorized in DOD Directive 1145.1⁷⁸ and this categorization can be seen in Table 5. An enlistee has to be in the Category IV or above to be accepted to the U.S. military. Maximum, minimum, and mean values of AFQT scores for the enlisted personnel and officers in the SMCR are depicted in Figure 11.

Table 5. Classification of the AFQT Scores⁷⁹

Category	Definition	Percentile Scores
I	Above Average	93-99
II	Above Average	65-92
IIIA	Average	50-64
IIIB	Average	31-49
IV	Below Average	10-30
V	Markedly Below Average	1-9

⁷⁷ Dinsdale, "Modeling Incremental Initial," 42.

⁷⁸ Department of Defense, *Quality Distribution of Military Manpower*, Department of Defense Directive 1145.1, Washington, DC: DOD, last modified November 21, 2003, 2, <http://biotech.law.lsu.edu/blaw/dodd/corres/pdf2/d11451p.pdf>.

⁷⁹ Ibid., 2.

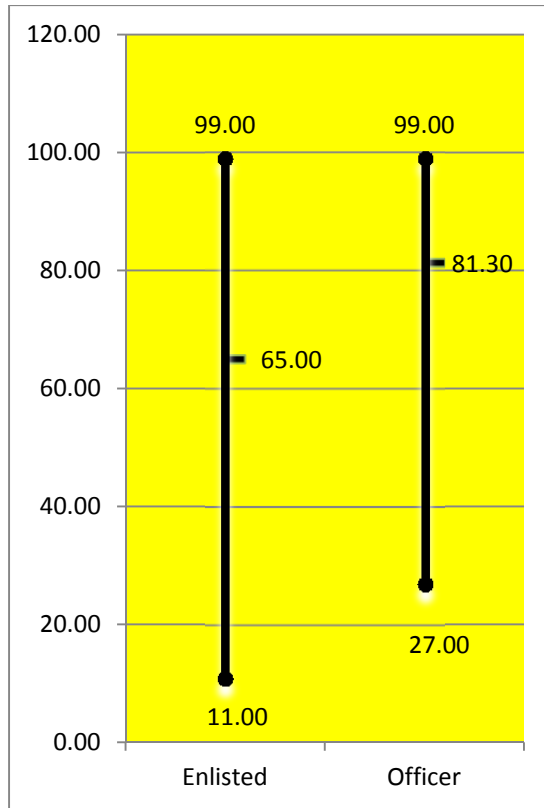


Figure 11. Maximum, Minimum, and Mean Values of AFQT Scores for Enlisted Personnel and Officers

b. Physical Fitness Test (PFT)

PFT is another proxy which can be used to assess the effect of ability on continuation decisions of the Marines. The PFT is a semi-annual test that evaluates the physical conditions of individual Marines. The PFT consists of three sub-categories: 3-mile run, crunches, and pull-ups. Each of these sub-categories has a maximum score of 100; the aggregate PFT score is calculated by summing these sub-category scores. Hence, the maximum score for the PFT is 300. This study uses the classification of the PFT scores, which is described in Marine Corps Order P6100.12, to categorize the PFT scores in the data. This classification is depicted in Table 6.

Table 6. Classification of the PFT Scores⁸⁰

Class	Age 17–26	Age 27–39	Age 40–45	Age 46+
1 st Class	225–300	200–300	175–300	150–300
2 nd Class	175–224	150–199	125–174	100–149
3 rd Class	135–174	110–149	88–124	65–99

The scores below the 3rd Class scores are considered to be “failures.” Findings in the literature suggest that higher PFT scores are associated with the lower attrition probability. For example, Dinsdale finds that higher PFT scores decrease the attrition probability.⁸¹ Lizarraga also concludes that Marines who have the score of 2nd class and below are less likely to continue.⁸² There are three binary variables in the multivariate models to assess the effect of PFT scores on the attrition. These are *pft_1st*, *pft_2nd* and *pft_3rd*. These variables take the value of “1” if the Marine reservist is in the related category and “0” otherwise. Figure 12 shows the distribution of officers and enlisted personnel by their PFT score category separately.

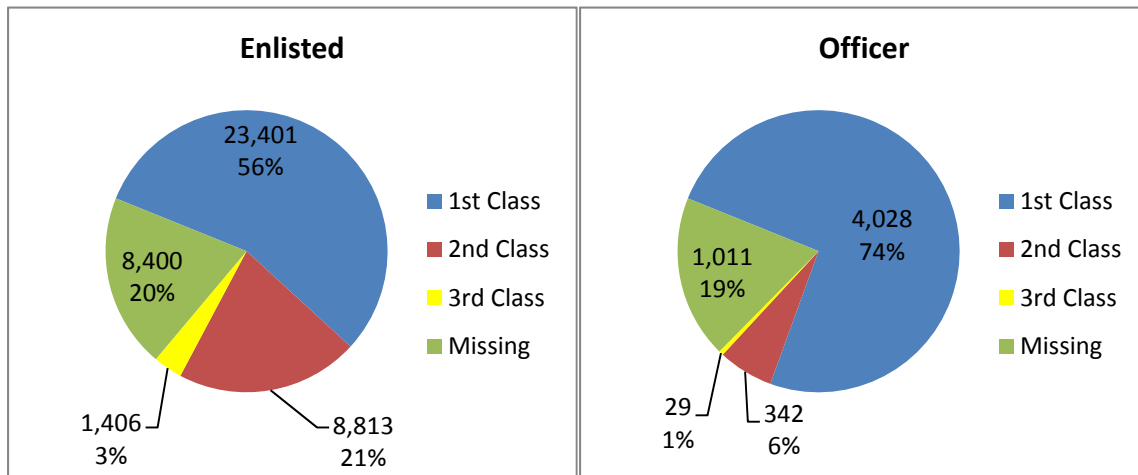


Figure 12. Composition of PFT Scores for Officers and Enlisted Personnel

⁸⁰ United States Marine Corps, *Marine Corps Physical Fitness Test and Body Composition Program Manual (Short Title: MCPFTBCP)*, Marine Corps Order P6100.12, Washington, DC: Department of the Navy, May 2002, 2–9, http://navy.rotc.umich.edu/wp-content/uploads/2013/09/Marine_Corps_PFT_Standards.pdf.

⁸¹ Dinsdale, “Modeling Incremental Initial,” 59.

⁸² Lizarraga, “Patterns of Marine Corps,” 122.

c. Proficiency and Conduct (Pro/Con) Marks

Proficiency and Conduct Marks are given to enlisted Marines who hold the rank of corporal (E-4) and below on a semi-annual basis. These marks are important assessments of the military ability that the Marines possess. Proficiency marks assess how a Marine performed on his primary duty and evaluates attributes such as mission accomplishment, individual character, intellect and wisdom, and physical fitness.⁸³ The conduct mark is “a fair objective evaluation of the Marine’s conduct for the marking period”⁸⁴ and takes into consideration qualities such as general bearing, courtesy, moral fitness, influence on others, and participation in activities that are not related to unit mission.⁸⁵ So these marks contain valuable information to assess the ability and aptitude of the individuals. Pro/Con marks have a range of 0 to 5.0; 0 to 3.9 is considered “below average,” and 4.0 to 4.4 is considered “average.” Likewise, 4.5 to 4.8 and 4.9 to 5.0 are “excellent” and “outstanding,” respectively. These marks are included as averaged marks in the data, and there were 17,210 and 17,208 observations for proficiency and conduct marks, consecutively, which have the value of “0.” These values are considered missing values because “0” is not considered to be an appropriate value for Pro/Con marks. To assess the effects of Pro/Con marks, the continuous *pros* and *cons* variables are identified and included in the enlisted model only. These variables take the value of average Pro/Con marks that an individual is assigned. Also, these marks are multiplied by 10 to make the interpretation easier for the readers. Literature suggests that increased Pro/Con marks lower the attrition probability.⁸⁶ However, it should be noted that these marks are assigned by human assessment and therefore include bias. Figure 13 provides the average Pro/Con marks for the enlisted personnel in the data.

⁸³ United States Marine Corps, *Marine Corps Individual Records Administration Manual (Short Title: IRAM)*, Marine Corps Order P1070.12, Washington, DC: Department of the Navy, July 2000, 4–42, <http://www.quantico.marines.mil/Portals/147/IRAM.pdf>.

⁸⁴ Ibid., 4–39.

⁸⁵ Ibid., 4–39.

⁸⁶ Herschelman, “United States Marine Corps Reserve,” 63.

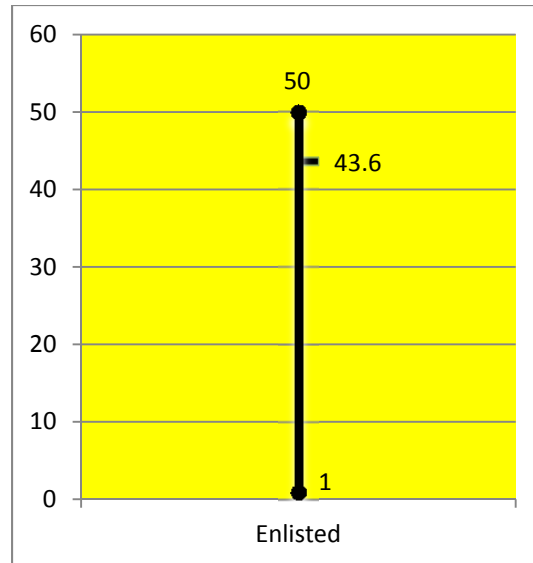


Figure 13. Maximum, Minimum, and Mean Values of Pro/Con Marks for Enlisted Personnel

d. Waivers

Waivers are used to enable the accession of officers and enlisted personnel in the military who normally would be disqualified because of some reasons like involving in non-serious offenses or having unfavorable specialties. There are numerous types of waivers such as conduct, medical, dependent, age, tattoo, or drug. There are also subcategories for each of them. For example conduct waivers consist of serious non-traffic, minor non-traffic, felonies, serious traffic, minor traffic, and substance-abuse offenses. Explaining all types of the waivers is beyond the scope of this study. If a potential enlistee is otherwise ineligible due to one the reasons explained here, that individual may seek a waiver and, if accepted, would be allowed to enter the Marine Corps. As the military increases the number of recruits each year, the number of people who have waivers, and also the rate of these individuals in the military, increase.⁸⁷ This fact makes the issue of waiver important consideration for the researches who examine the attrition problem in the military. Distifeno finds that having a conduct waiver

⁸⁷ Christopher Distifeno, "Effects of Moral Conduct Waivers on First-Term Attrition of U.S. Army Soldiers" (master's thesis, Naval Postgraduate School, 2008), 2, <http://calhoun.nps.edu/bitstream/handle/10945/33786/NPS-HR-08-008.pdf?sequence=1>.

increases the attrition probability in the Army.⁸⁸ To assess the effect of waivers and the magnitude of the problem, this study identified the binary variable *waiver* which takes the value of “1” if the individual has any kind of waiver and “0” otherwise. Because the data set for officers does not include the waiver information, this variable is only included in the model for the enlisted personnel. Rather than categorizing the waiver types and examining the effects of each of them, waivers are lumped into one single variable. Because, the people who have any kind of waivers in the data is only 18%. Figure 14 presents the waiver composition of enlisted Marines in the data set.

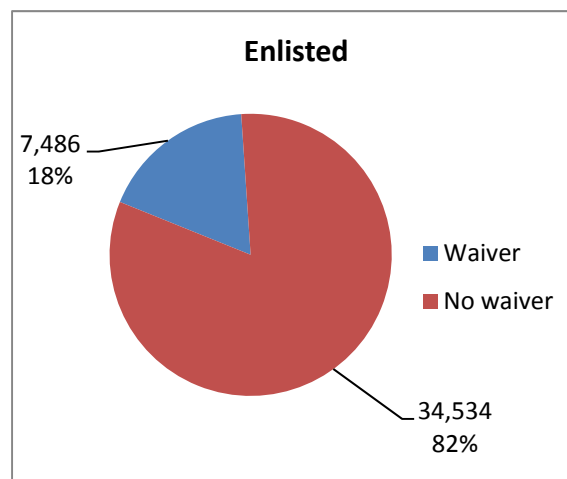


Figure 14. Composition of Waiver Status for Enlisted Personnel

3. Military Characteristics

This category includes the variables which are related to military environment, specifically, rank and unit type.

a. Rank

Rank is an important indicator which provides valuable information about the military characteristics, ability, and performance of the individual Marines. It is possible that individuals who are more devoted to the Marine Corps and who enjoy the military lifestyle will stay in the Marine Corps longer and will achieve higher rank. Hence, this

⁸⁸ Ibid., 43.

information is important when examining the attrition behavior of Marines. The original data includes the ranks of the individual officers and enlisted Marines, but these ranks get higher as the sequence number increases because the individuals continue to be promoted during their first term as well. Hence, this study takes into consideration the ranks of individuals when they are attritted or reached their MDPSP. There are eleven binary variables in this study for the warrant officers and officers which are labeled as *W1*, *W2*, *W3*, *W4*, *W5*, *O1*, *O2*, *O3*, *O4*, *O5*, and *O6*. For the enlisted personnel, there are five binary variables which are *E2*, *E3*, *E4*, *E5*, and *E6*. These variables take the value of “1” if the Marine has the relevant rank and “0” otherwise. Figures 15 and 16 depict the distribution of the officer and enlisted Marines by their ranks separately.

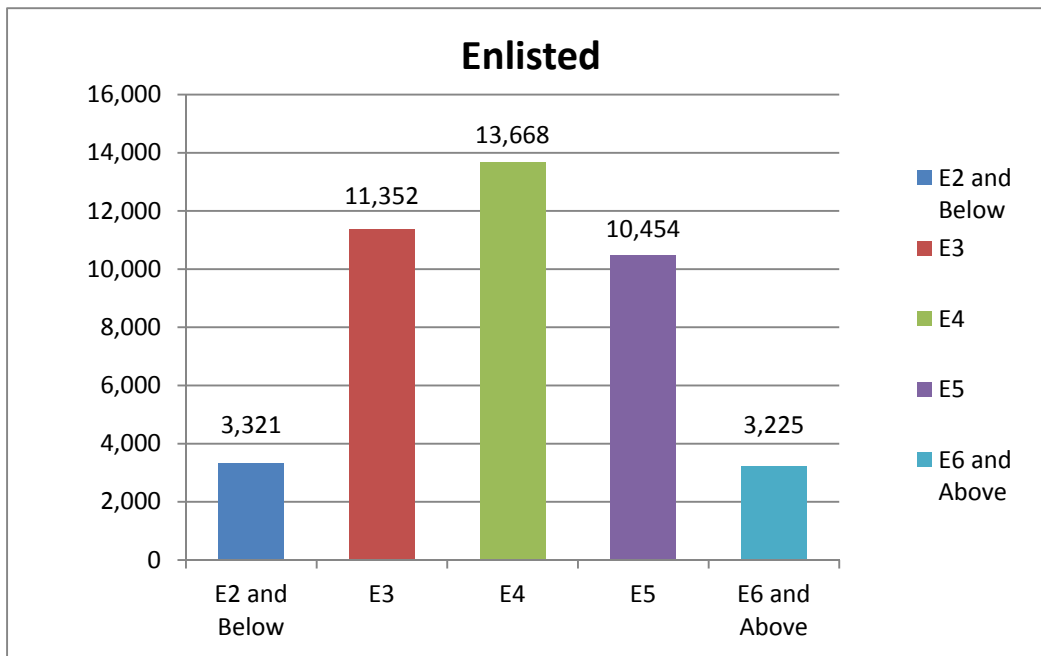


Figure 15. Composition of Rank for Enlisted Personnel

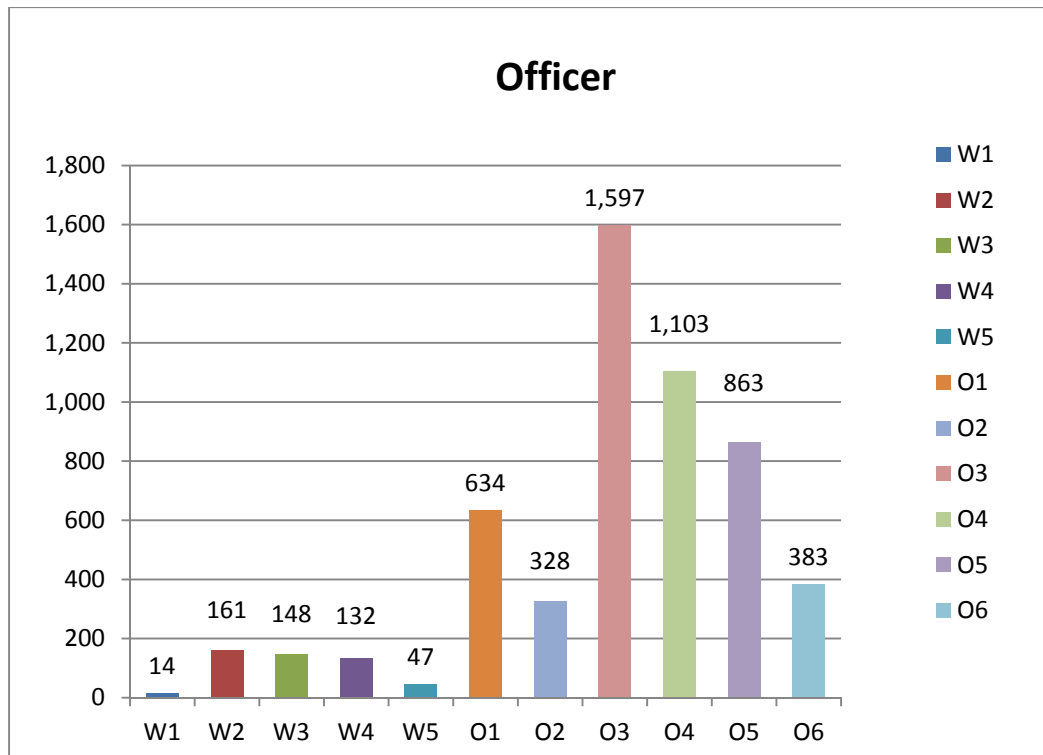


Figure 16. Composition of Rank for Officers

b. Occupational Specialty

Each Marine in the Marine Corps is assigned one of the three MOS which shape their specific job characteristics and their working environment. These categories are Combat Arms, Aviation, and Support. The culture, work climate, and interpersonal relationships may differ from unit to unit and these factors may affect the Marines differently. Also, it is possible that some specialized skills, such as those in air wing units, may be highly demanded in the civilian sector and experience higher attrition rates.⁸⁹ Besides, it is very important that the demands, abilities, and knowledge of the workers should be consistent with the conditions and the requirements of the working environment. This fact is called person–job fit and it has a considerable effect on the continuation behavior of individual Marines. Considering these facts, research that examines the attrition or continuation rates in the military should include these variables in their models. Prior studies suggest that MOS has significant effects on attrition rates,

⁸⁹ Lizarraga, “Patterns of Marine Corps,” 78.

although the results are mixed and inconsistent. For example, Lizarraga concludes that while Marines who are affiliated with the aviation MOS are more likely to continue, individuals in the support MOS have more attrition rates.⁹⁰ On the contrary, Herschelman finds that Marine reservists who are with aviation MOS are more likely to attrit.⁹¹ To control for and to capture the effect of the MOS on attrition probability, this study includes the following MOS variables which are: combat arms, which includes infantry, armor, and artillery; aviation, which includes aviation-related branches such as aircraft maintenance and air traffic control; and support, which includes the rest of the branches. These variables are binary and labeled as *combat_mos*, *aviation_mos* and *support_mos* consecutively. They take the value of “1” if the individual is in the related category and “0” otherwise. Because there are no aviators in the enlisted personnel according to the data set, only the combat arms and support categories are included in the model for enlisted personnel. Figure 17 depicts the distribution of officers and enlisted personnel by their MOS separately.

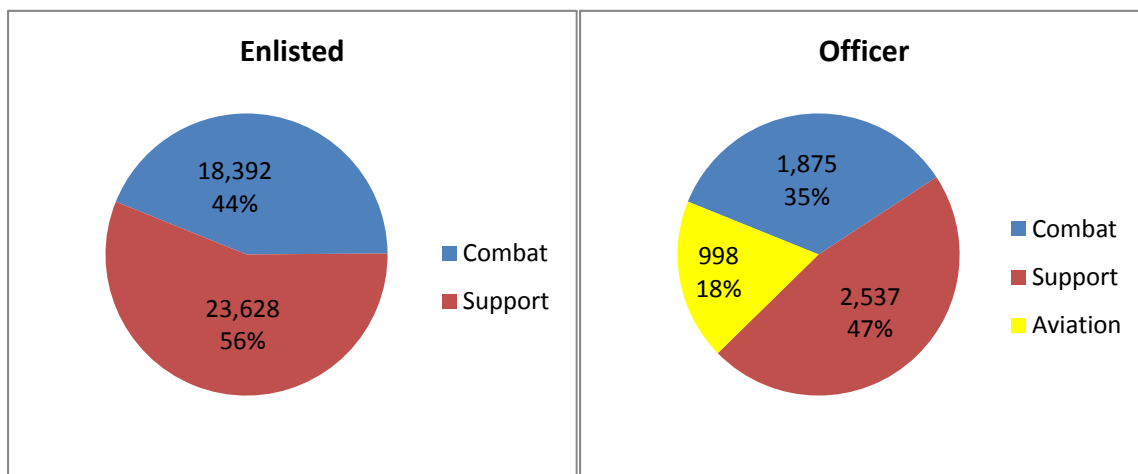


Figure 17. Composition of MOS for Officers and Enlisted Personnel

⁹⁰ Ibid., 122.

⁹¹ Herschelman, “United States Marine Corps Reserve,” 63.

4. Geographic Characteristics

This category includes the variables which are related to geographic characteristics, specifically, hometown and unemployment rate.

a. Hometown

Different regions have different characteristics such as economic conditions, demographic conditions, and support for military. These factors affect the attrition probability of the Marines in the SMCR. In accordance with the Census Bureau of the United States' division of the country into nine regions, this study assigns each Marine Reservist to a region of the United States based on each reservist's hometown state. These regions are Midwest East, Midwest West, New England, Mid-Atlantic, South Atlantic, Southeast Central, Southwest Central, West Mountain, and West Pacific. Figure 18 depicts these regions and the states they include. Previous research in the literature finds mixed and insignificant results about the geographic region of the Marines. For example, while Lizarraga concludes that Southeast, Mid-Atlantic, West Mountain, and New England regions have more attrition rates in one of his models, findings in his other models are insignificant.⁹² Similarly, Herschelman also finds inconsistent results in his models. Hometown is a binary variable and takes the value of "1" if the individual is in the related region and "0" otherwise. This variable is labeled as *home_MidwestEast*, *home_NewEngland*, and so forth. Figures 19 and 20 show the distribution of the officers and enlisted Marine reservist by their hometown separately.

⁹² Lizarraga, "Patterns of Marine Corps," 123.



Figure 18. Census Regions and Divisions of the United States⁹³

⁹³ United States Census Bureau, *Geographic Areas Reference Manual*, Washington, DC: Department of Commerce, 1994, accessed February 9, 2015, <https://www.census.gov/geo/reference/pdfs/GARM/Ch6GARM.pdf>.

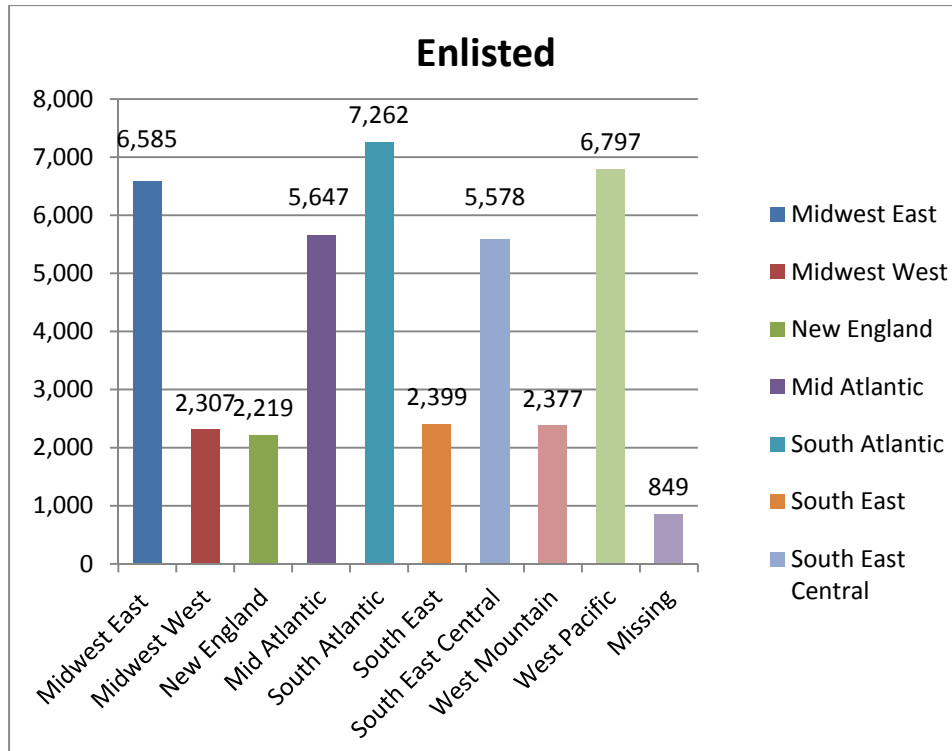


Figure 19. Composition of Home of Record Region for Enlisted Personnel

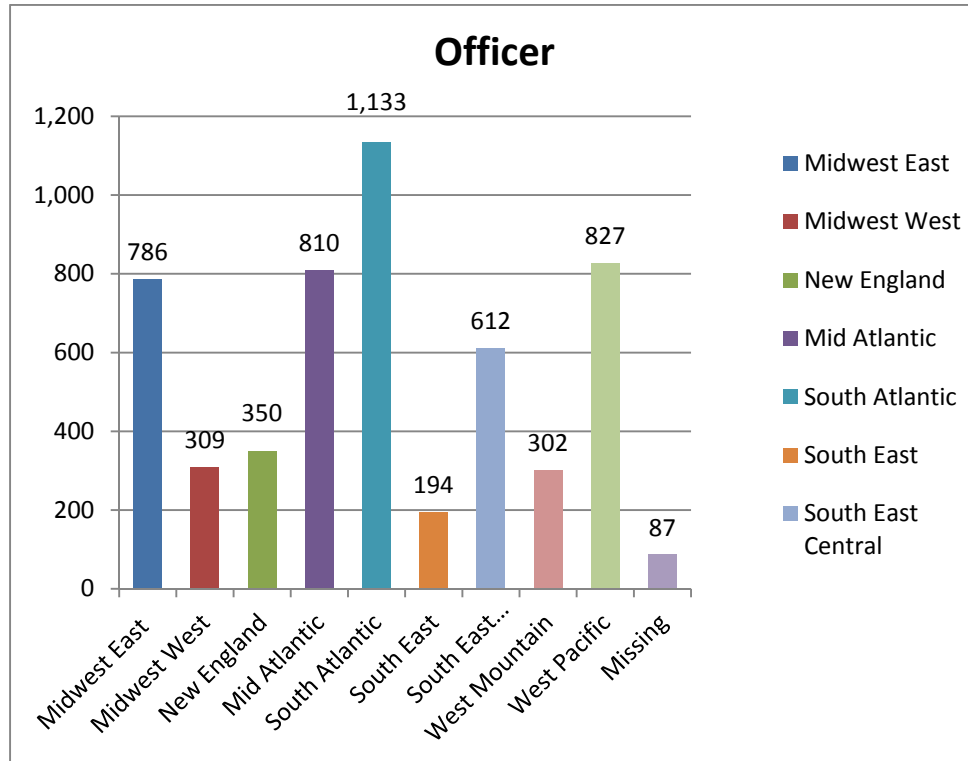


Figure 20. Composition of Home of Record Region for Officers

b. Unemployment Rate

The unemployment rate can have a significant effect on the continuation decision of individual Marines. Price suggests that when the unemployment rate increases, continuation rate increases as response.⁹⁴ Hence, to assess the effect of unemployment rate on the attrition probability for the SMCR, the variable *unemp* is included in the models. This is a continuous variable which takes the value of unemployment rate of the hometown state of the each individual when the Marine reservist is attritted or reaches the MDPSD.

5. Fiscal Year Cohorts

Unique and significant events such as 9/11 or an economic crisis in each year may affect the continuation behavior of the Marines in the SMCR. For this reason, fiscal year cohorts are created and individuals are included in these cohorts based on their respective PEBD. The fiscal year cohort is a binary variable and takes the value of “1” if the individual is in the related category and “0” otherwise. This variable will enable us to detect any differences if present between the years 2001 and 2010. Dinsdale finds that attrition rate increases with the time.⁹⁵ This variable is labeled as *FY* followed by two digit numbers representing the year (*FY01*, *FY02*, etc.). Figures 21 and 22 depict the distribution of the officers and enlisted personnel by their Fiscal Year cohorts separately.

⁹⁴ Price, “Effects of Activation,” 109.

⁹⁵ Dinsdale, “Modeling Incremental Initial,” 59.

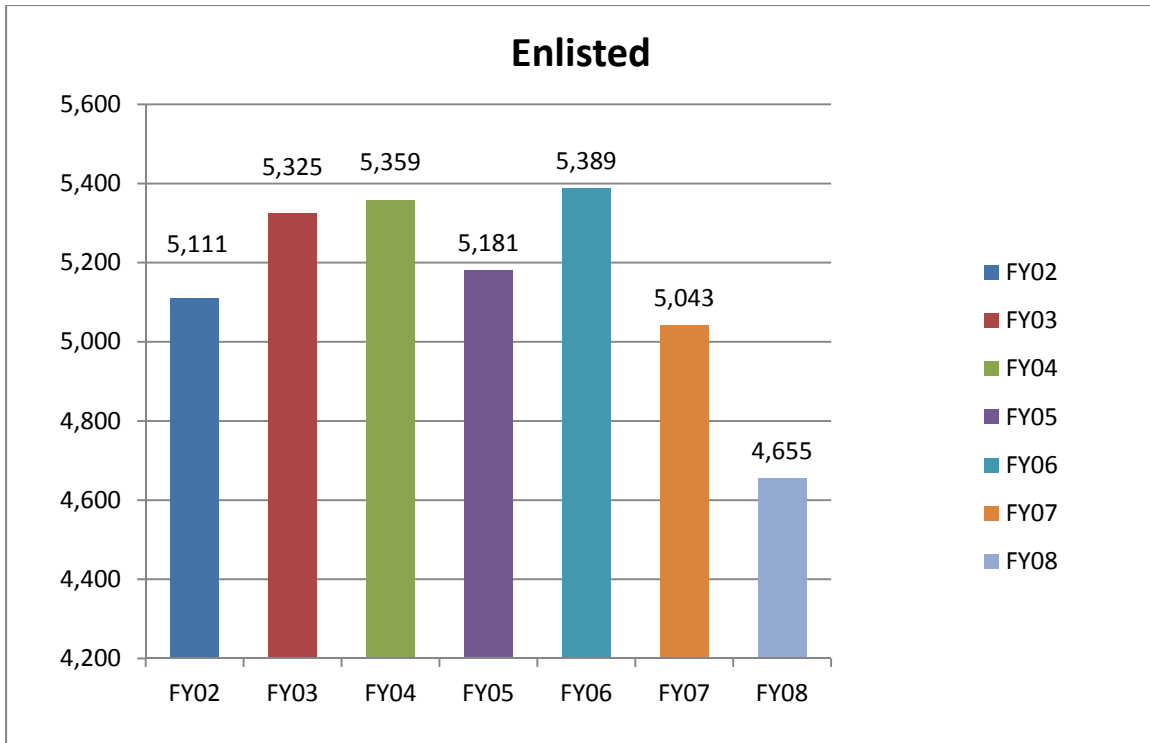


Figure 21. Cohort Distribution for Enlisted Personnel

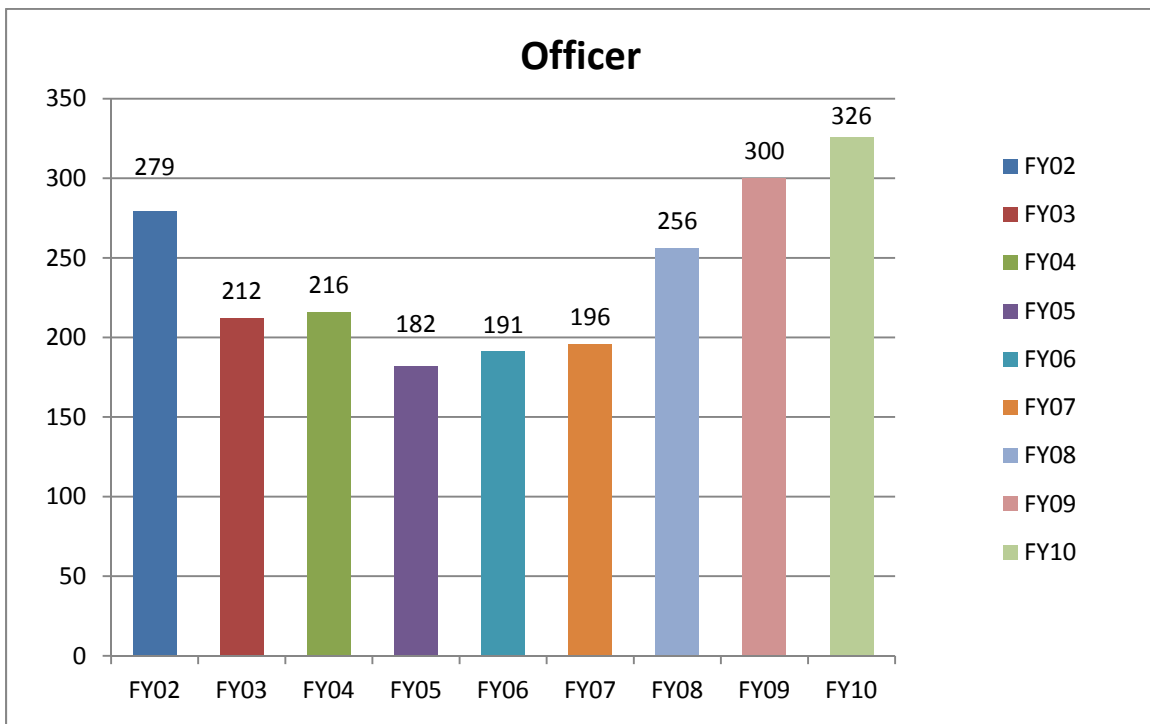


Figure 22. Composition of Cohorts for Officers

F. DATA LIMITATIONS

The goal of this thesis is to determine the causes of first-term attrition for the officers and enlisted personnel in the SMCR. Although the models which are employed in this thesis provide valid and sound findings to estimate the causes of the attrition and their magnitude, there are some limitations to keep in mind which affect the predictive ability of the models.

There are many missing values and inconsistencies in both of the data sets. For example, PFT scores category includes 8,400 missing values for enlisted personnel and 1,011 missing values for officers. These numbers account for the 17% of the officers and 20% of the enlisted personnel in the data sets. Further, the dates, such as the expiration of the current contract and PEBD, include illogical records such as October 2097. Also, some variables include categories like “declined to answer” or “choose not to answer.” These categories are merged with either *other* sub-category within the variable or considered as missing value. For example, 272 observations for officers and 4,886 observations for enlisted personnel, which account for the 5% and 12% of the total observations consecutively, were converted to missing value. Because of these restraints in the data sets, the predictive ability of the models for attrition is negatively affected.

G. SUMMARY

This chapter describes the data that was used in the research; the data was cleaned and coded prior to use in the model. Also, the dependent and independent variables are introduced and explained in detail. Lastly, the limitations of the data and results of these limitations are provided.

The dependent variable in this thesis is *attrition*, which takes the value of “1” if the individual fails to complete his initial service contract and “0” otherwise. The independent variables consisted of the following:

- Demographics (Gender, Race, Education, Marital Status, Number of Dependents, and Age)

- Ability and Aptitude (AFQT Scores, Pro/Con Marks, PFT Scores, and Waivers)
- Military Characteristics (Rank and MOS Category)
- Geographic Characteristics (Hometown and Unemployment Rate)
- Fiscal Year Cohorts (between 2001 and 2013)

The variables used in the models help to better predict the causes of enlisted attrition and officer attrition in the SMCR. The findings about the determinants of attrition will help the personnel decision-makers in the Marine Corps to better understand the attrition behaviors of the Marines in the SMCR and employ suitable and accurate policies to solve the problems related to attrition.

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IV. DESCRIPTIVE STATISTICS

This chapter presents descriptive statistics and compares the results of the data from 2001 to 2014.

A. DESCRIPTIVE STATISTICS

Summary statistics of the enlisted personnel and officer data sets are shown in Appendix A. Each variable is presented in one of three categories for each data set: (1) full sample, (2) attritted, and (3) not attritted. There are two lines for each variable: the first line presents the mean values, and the second line presents the standard deviation in parenthesis. The comparisons and assessments in this chapter are made considering this table.

The data sets contain observations between 2001 and 2008 for enlisted personnel, and between 2001 and 2014 for officers.

B. COMPARISON OF THE RESULTS

In accordance with the variable categorization introduced previously in Chapter III, this section presents comparisons of the results and assessments about variables which are closely related in attrition.

1. Demographics (Gender, Race, Marital Status, Dependents, Age, Education Level)

Demographic factors can be significant determinants in the decision to stay in or leave the RC and are always examined in attrition studies. The characteristics of human populations provide insight into whether there is a relationship between attrition probability and a certain segment of the population. The attrition percentages of demographics for officers and enlisted personnel are shown in Figures 23 and 24.

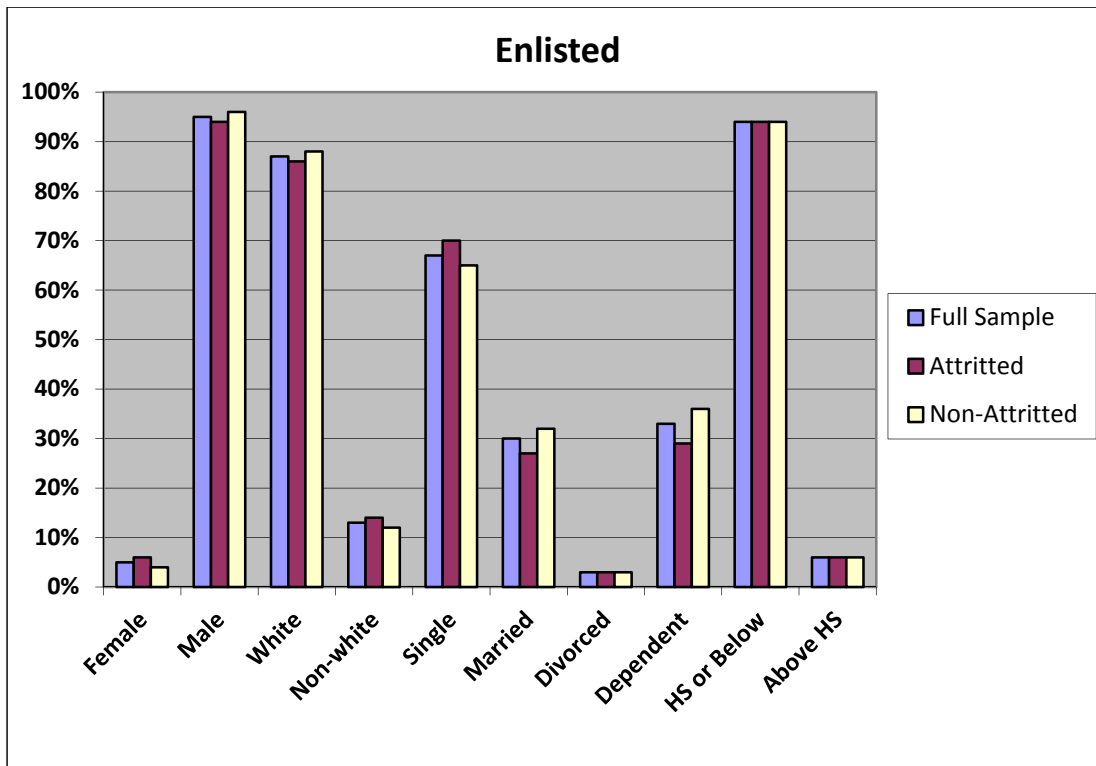


Figure 23. Demographics Percentages of Enlisted Personnel

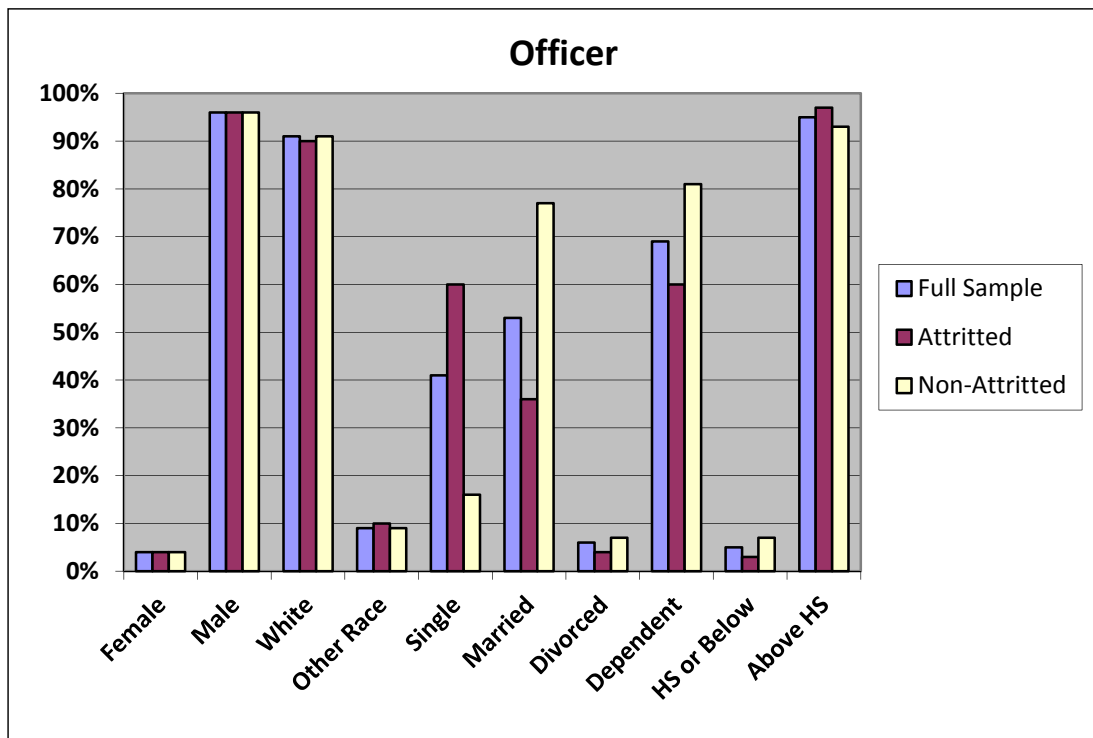


Figure 24. Demographics Percentages of Officers

Descriptive statistics of both data sets allow us to make superficial examinations to reach preliminary findings about attrition. According to the results, gender does not seem to have a significant effect on attrition. For example, for enlisted personnel, although the percentage of females is high for the attritted population, the difference is little, only 1 percentage point. For officers, the percentage of females in the attritted and non-attritted population is the same, 4%.

Similarly, race variables also yield the same results as the gender. While whites consist of 87% of the entire population of enlisted personnel, they make up 91% of the officers. Though the white Marines in the attritted portion of the populations are less than the Marines in the attritted portion, the difference is 2 and 1 percentage points for the enlisted personnel and for officers, consecutively.

Variables for marital status, especially being single and married, have significant effects on the attrition based on the descriptive statistics results. The difference is more obvious for officers. While the percentage of single reservists in the attritted group is 5 percentage points more than the percentage of singles in the non-attritted group for enlisted personnel, the difference is 44 percentage points for officers. Similarly, the difference for married reservists is 5 and 41 percentage points for enlisted personnel and for officers, consecutively. Based on these results, it can be concluded that being married decreases the attrition probability for the Marine reservists, especially for the officers. However, divorced Marines are distributed evenly between the groups, which provides no evidence about the attrition behavior of enlisted personnel. But officers who are divorced are associated with lower attrition probabilities since the percentage of officers in the non-attritted group is greater than the percentage of divorced officers in the attritted group by 3 percentage points.

Another factor which reduces the attrition probability according to the descriptive statistics is the dependent status. Having one or more dependents decreases the attrition probability of the Marines since the individuals in the non-attritted groups who have dependents are greater than the Marines in the attritted group. Specifically, the difference is 7 and 21 percentage points for enlisted personnel and officers, successively. Likewise, age decreases the attrition probability for both populations. The approximate age is 25

years for enlisted personnel and 37 years for officers. The non-attributed group is approximately two years and eight years older than the attributed group for enlisted personnel and officers, consecutively. Hence, especially for the officers, age is positively associated with the attrition behavior of the Marines.

One of the striking findings in the education category is the difference in the education levels of the Marines. While 95% of the officers have an education above the high school level, this rate is only 6% for the enlisted Marines in the SMCR. Although this is the case, education levels do not seem to have a major role in the attrition behaviors of the Marines. The enlisted Marines are distributed evenly among the education categories. Similarly, the difference between the attributed and non-attributed group for the officers is only 4 percentage points.

2. Ability and Aptitude (AFQT Score, PFT Scores, Pro/Con Marks, Waivers)

Ability and aptitude are also important factors to identify the causes of attrition. As mentioned previously, ability and aptitude indicators, such as AFQT score, Pro/Con marks, and PFT scores, are closely related to military performance and provide significant information about a reservist's motivation, adaptability, and person-job fit. Therefore, they are good identifiers for whether a reservist will decide to stay in or leave the SMCR. The attrition percentages of ability and aptitude variables for officers and enlisted personnel are shown in Figures 25 and 26.

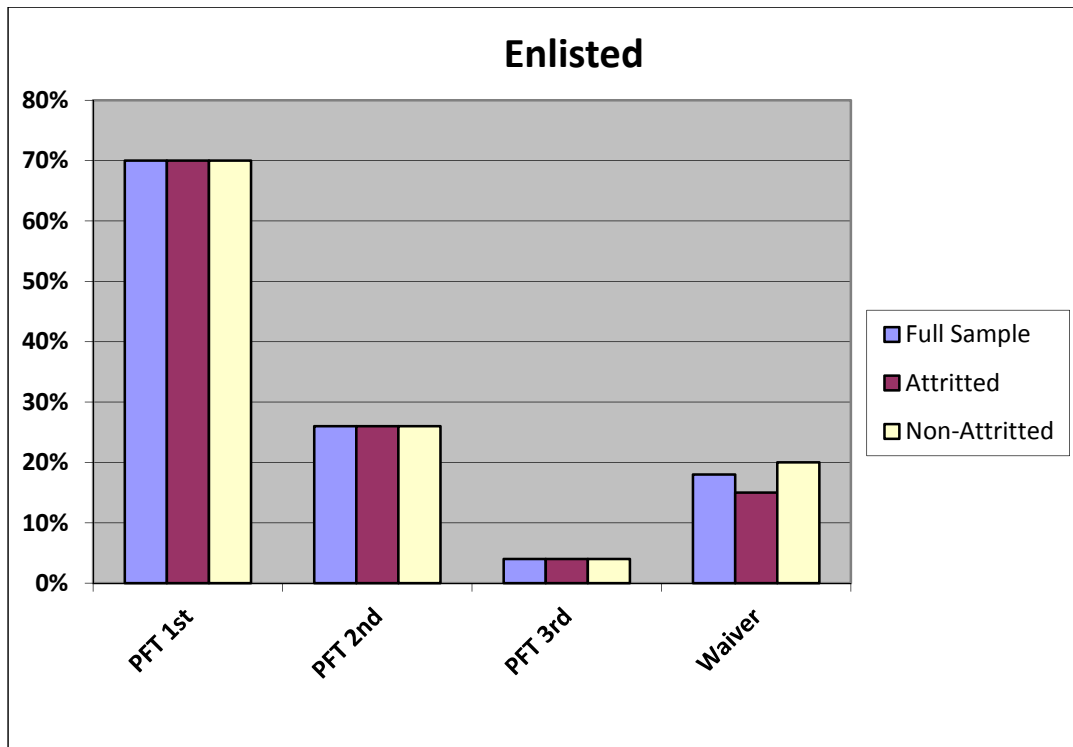


Figure 25. Ability and Aptitude Indicators Percentages of Enlisted Personnel

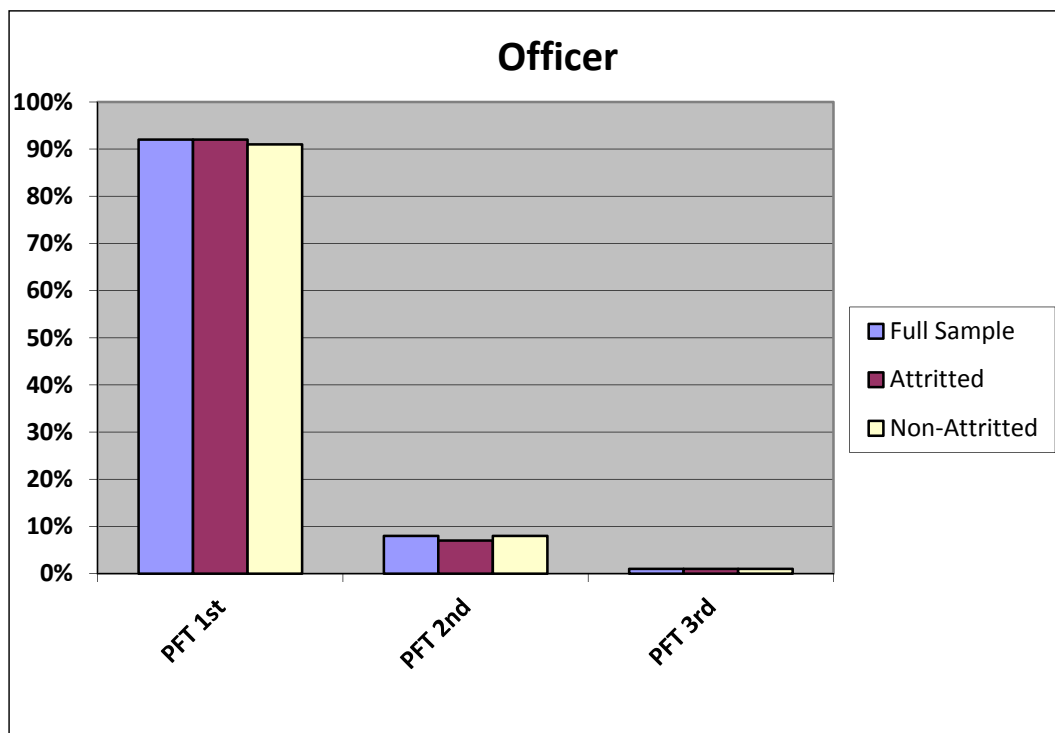


Figure 26. Ability and Aptitude Indicators Percentages of Officers

AFQT scores differ slightly between the attritted and non-attritted groups of both populations but suggest contrary conclusions for each of them. For example, the average AFQT score of the non-attritted group of enlisted personnel is higher than the average AFQT score of the attritted group. Specifically, the score of non-attritted group is 4.5 points more than the score of attritted group. However, the average AFQT score of attritted group of officers is 2 points higher than the score of the non-attritted group. These results suggest that higher AFQT scores are associated with lower attrition probabilities for enlisted personnel but higher attrition probabilities for officers.

The situation is different for PFT scores. The distributions of enlisted personnel and officers between the attritted and non-attritted groups are almost perfect. For example, there is no difference for the enlisted personnel, and the difference for the officers is only 1 percentage point for the 1st class PFT scores. Hence, there is not enough evidence to conclude significant results based on these statistics for PFT scores.

Pro/Con marks are only assigned to enlisted personnel who have a rank of E4 and below. Also, the data for officers do not include information about the waiver status for officers, so the Pro/Con marks and waivers will only be discussed for enlisted personnel. The average proficiency marks for the full population is 43.62, and average conduct marks is 43.56 for enlisted Marines. Both the Pro/Con marks and the percentage of Marines who have waivers are higher for the non-attritted group than the attritted one. The differences are approximately 1 point for Pro/Con marks and 5 percentage points for waiver status. Hence, it can be concluded that higher Pro/Con marks and having any kind of waiver decrease the attrition probability of the enlisted personnel in the SMCR.

3. Military Characteristics (Rank, Occupational Specialty)

The job characteristics such as status, hardship the individual faces in the job, opportunities, and work environment affect the motivation, satisfaction, and performance of individuals and thus are important in an individual's decision to stay in or leave the job. That is why pay grade and MOS category are included in the study to explain the relation between military characteristics and attrition. The attrition percentages of these categories are shown in Figures 27 through 30.

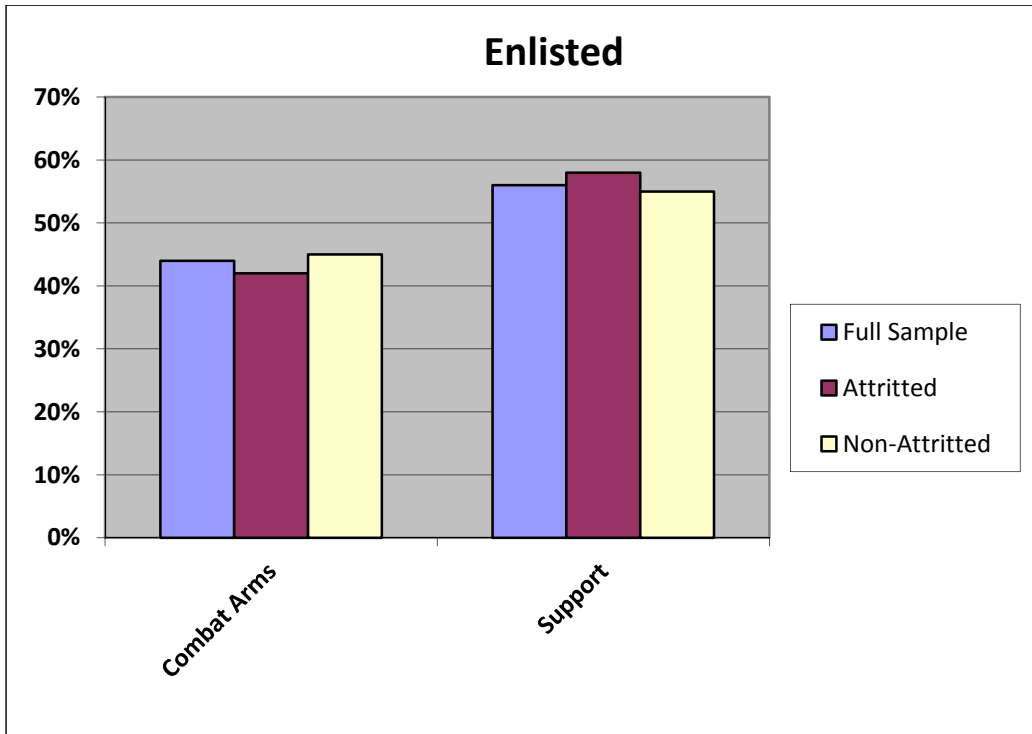


Figure 27. MOS Percentages of Enlisted Personnel

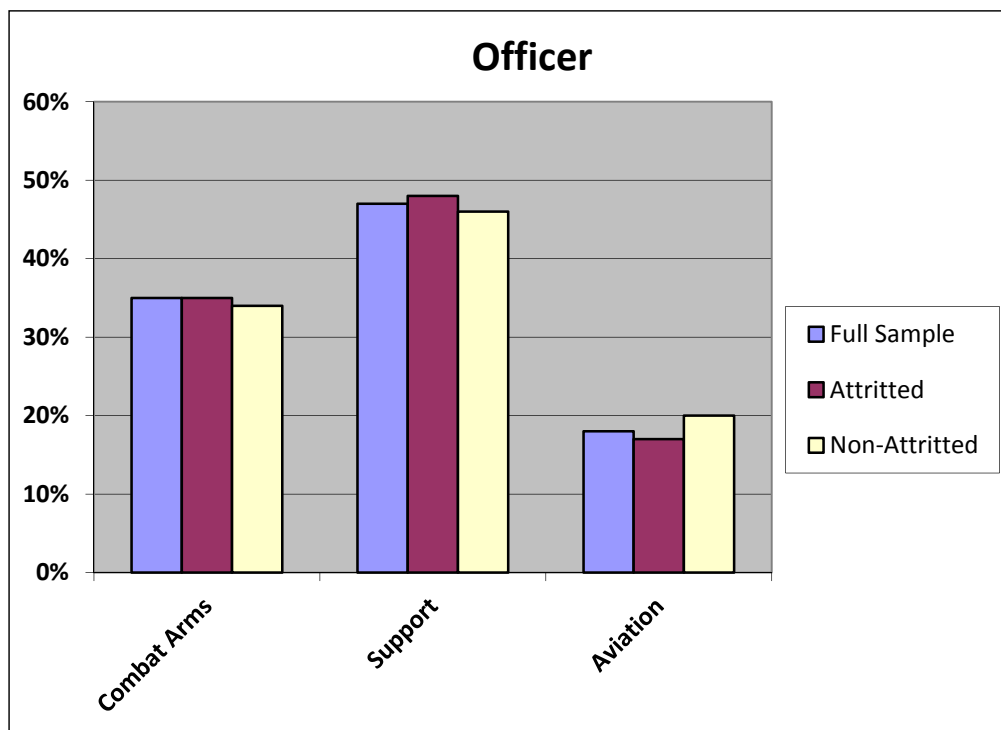


Figure 28. MOS Percentages of Officers

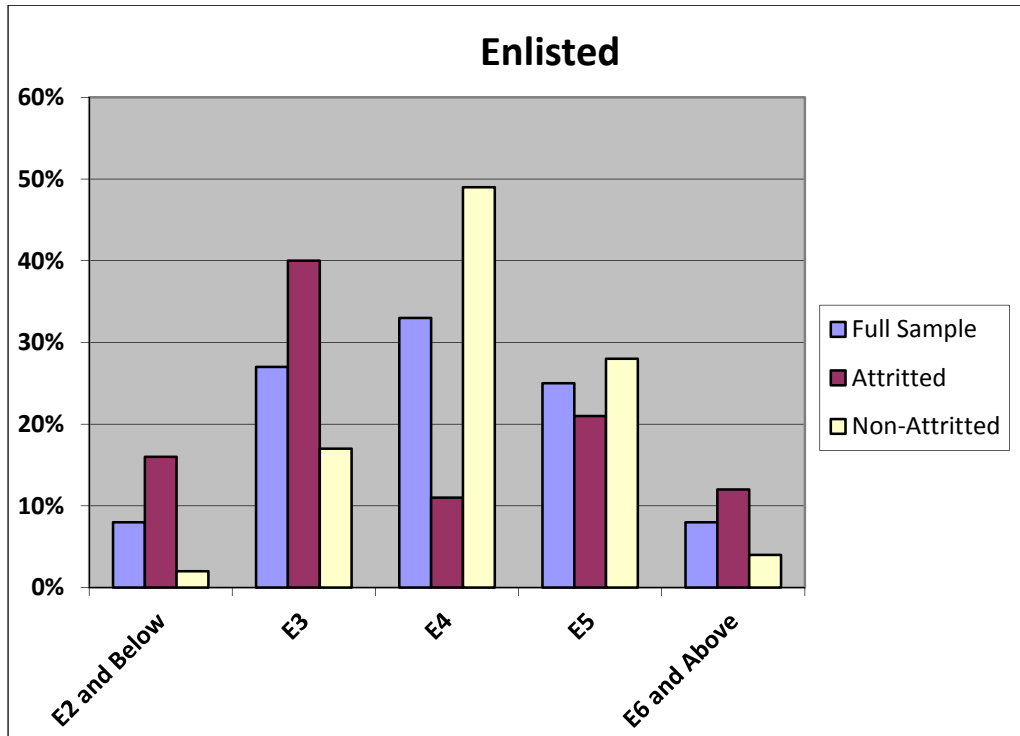


Figure 29. Rank Percentages of Enlisted Personnel

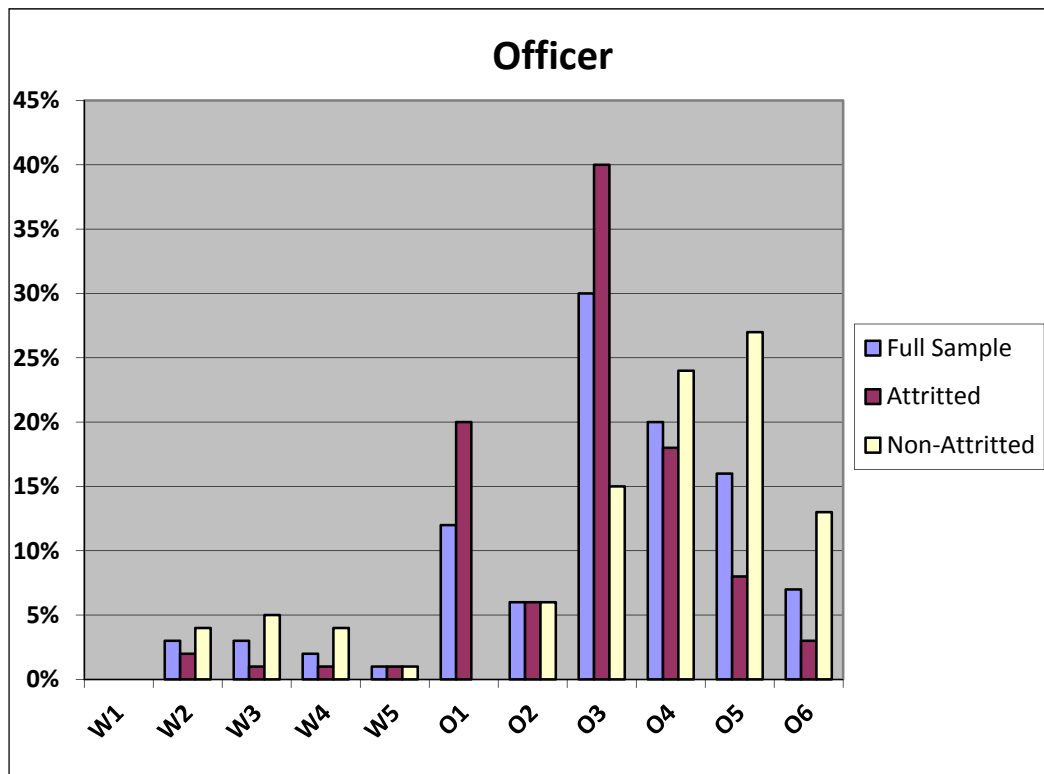


Figure 30. Rank Percentages of Officers

Rank seems to play important role for the attrition decisions of the both enlisted personnel and officers. For enlisted personnel, the effects of ranks differ significantly. While the percentage of Marines having a rank of E3 and below and E6 and above are higher in the attritted group than the non-attritted one, the effect reverses for the ranks of E4 and E5. The differences are 14, 23, and 8 percentage points for the ranks of E2, E3 and E6 consecutively and 38 and 7 percentage points for E4 and E5. These statistics imply that having a rank of E4 and E5 decreases the attrition probability, while the other ranks are associated with higher attrition probabilities for the enlisted personnel in the SMCR.

For the warrant officers, the effects are more consistent. The data includes very few officers who have the rank of W1. However, almost all other ranks for the warrant officers are associated with lower attrition rates. The percentages of officers who have the ranks of W2, W3, and W4 for non-attritted groups are greater than the attritted groups by 2, 4, and 3 percentage points consecutively. However, the distribution of the officers who have the rank of W5 is perfect for both groups. These results suggest that having a rank of W2 through W4 decreases the attrition probability of the warrant officers in the SMCR.

According to the statistics, the junior officers who have a rank of O3 and below have higher attrition probabilities, except the rank of O2 which has no difference between two groups, while the senior officers who have a rank of O4 and above experience lower attrition probabilities. The percentages of officers in the attritted group who have a rank of O1 and O3 are greater than the non-attritted group by 20 and 25 percentage points, successively. However, the O2s are distributed evenly between two groups. On the other hand, the percentages of officers in the non-attritted group who have a rank of O4, O5, and O6 are greater than the attritted group by 6, 19, and 10 percentage points consecutively. Based on these percentages, it can be concluded that junior officers have higher attrition probabilities, but as they get promoted this situation reverses.

In the data set for the enlisted personnel, there is no Marines who have an aviation MOS. So, enlisted personnel are divided into two MOSs: combat and support. According to the descriptive statistics, the effect of MOSs on attrition has opposite effects on

attrition for each population but these effects are not considerably significant for both the officers and enlisted personnel. For example, though the percentage of enlisted personnel who have combat MOS in the non-attrited group is higher than the attrited group, the difference is only 3 percentage points. The differences for officers are also very limited, only 1, 3, and 2 percentage points for the combat arms, aviation and support MOSs consecutively. In short, while having combat MOS decreases the attrition probability for the enlisted personnel, it increases the attrition probability for officers. Also for officers, aviators experience lower attrition probabilities as contrary to officers in the support units. But, the differences are small for both populations.

4. Geographic Characteristics (Hometown, Unemployment Rate)

Geographic characteristics of the places the reservists live vary across the United States. Support for military, civilian work environment, and patriotism are some examples of these characteristics. To control for these differences and to examine the effects of them are important to understand attrition behavior of the Marine Reservists. The attrition percentages of reservists' hometowns for enlisted personnel and officers are shown in Figure 31 and Figure 32, respectively.

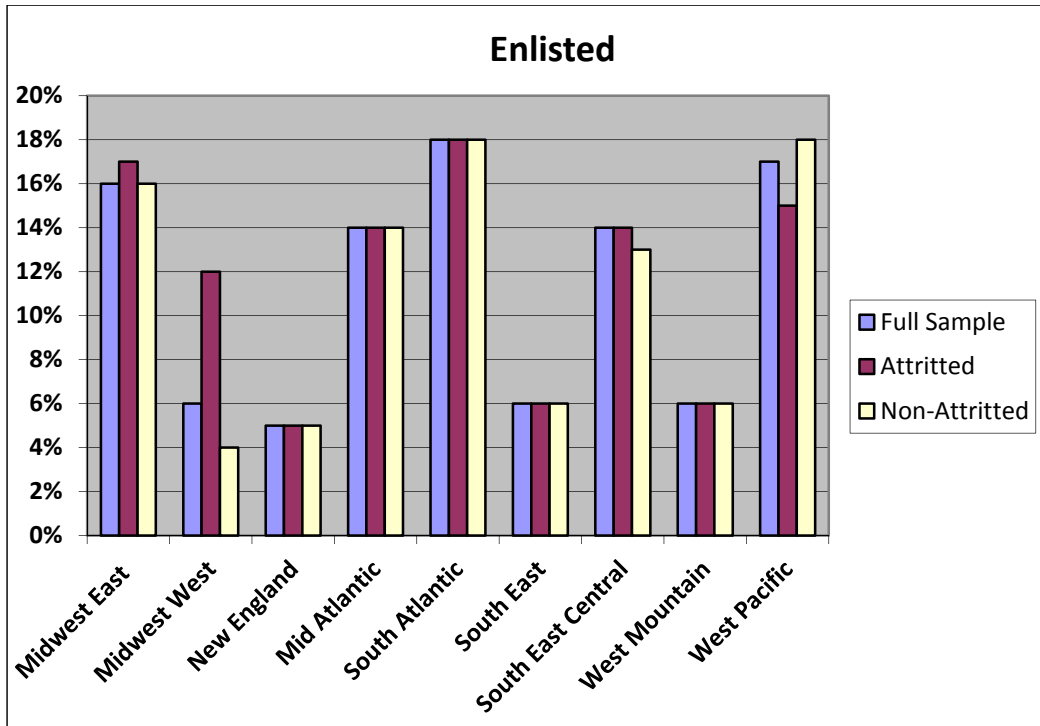


Figure 31. Home of Record Regions' Percentages of Enlisted Personnel

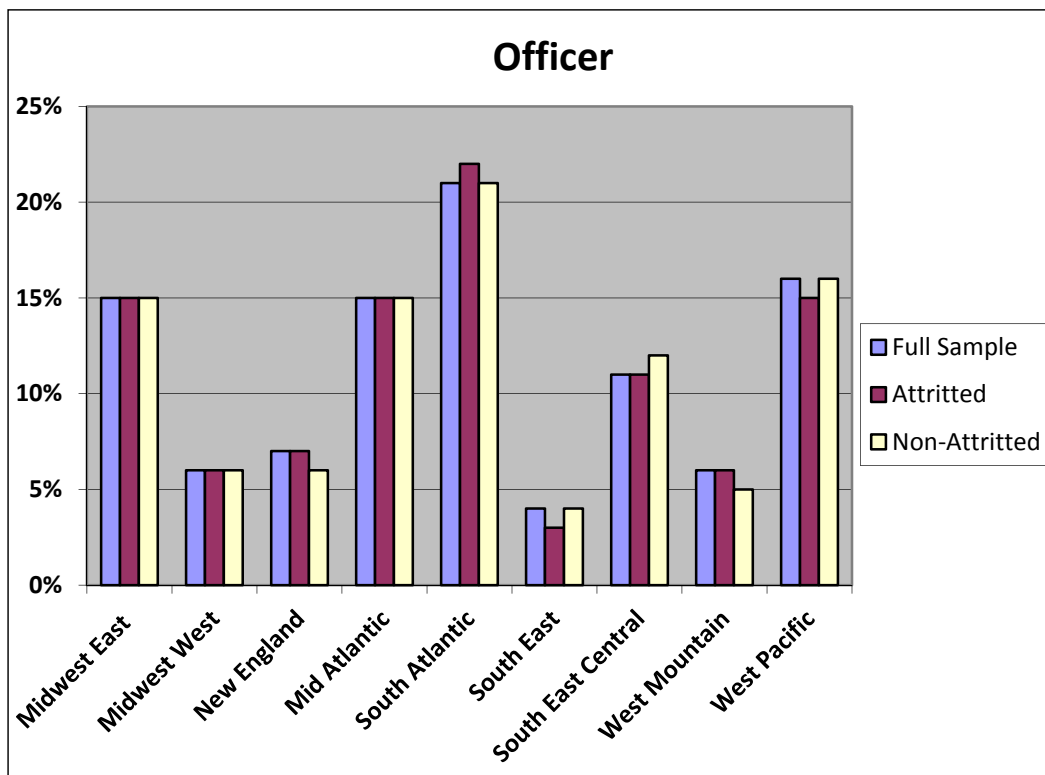


Figure 32. Home of Record Regions' Percentages of Officers

According to statistics, South Atlantic has the highest percentage for the enlisted personnel and officers for the full sample. The region which contributes the lowest number of Marines is New England for enlisted personnel and South East region for the officers. Almost all the numbers for the regions between attritted and non-attritted groups are distributed equally for both officers and enlisted personnel. With one exception, there is either no difference or only 1 percentage points between the groups. This exception is West Pacific region. For this region, non-attritted group is 3 percentage points higher than the attritted group for enlisted personnel which implies that Marines from that region experience lower attrition probabilities.

Average unemployment rates of the hometown states of Marines at their attrition dates or MDPSDs are 7.28% and 6.36% for enlisted personnel and Marines, respectively. For both populations, this rate is higher for the non-attritted groups though the difference is smaller for the officers. Specifically the difference is 0.9 and 0.29 percentage points for enlisted Marines and officers. This finding suggests that higher unemployment rates are associated with the lower attrition probabilities for both populations.

5. Fiscal Year Cohort (2001–2008 for Officers and 2001–2010 for Officers)

Literature states that attrition decreased in post-9/11 era. To show whether this situation exists and continues, fiscal year cohort variables are included in the study. The attrition percentages of fiscal year cohort variables are shown in Figures 33 and 34.

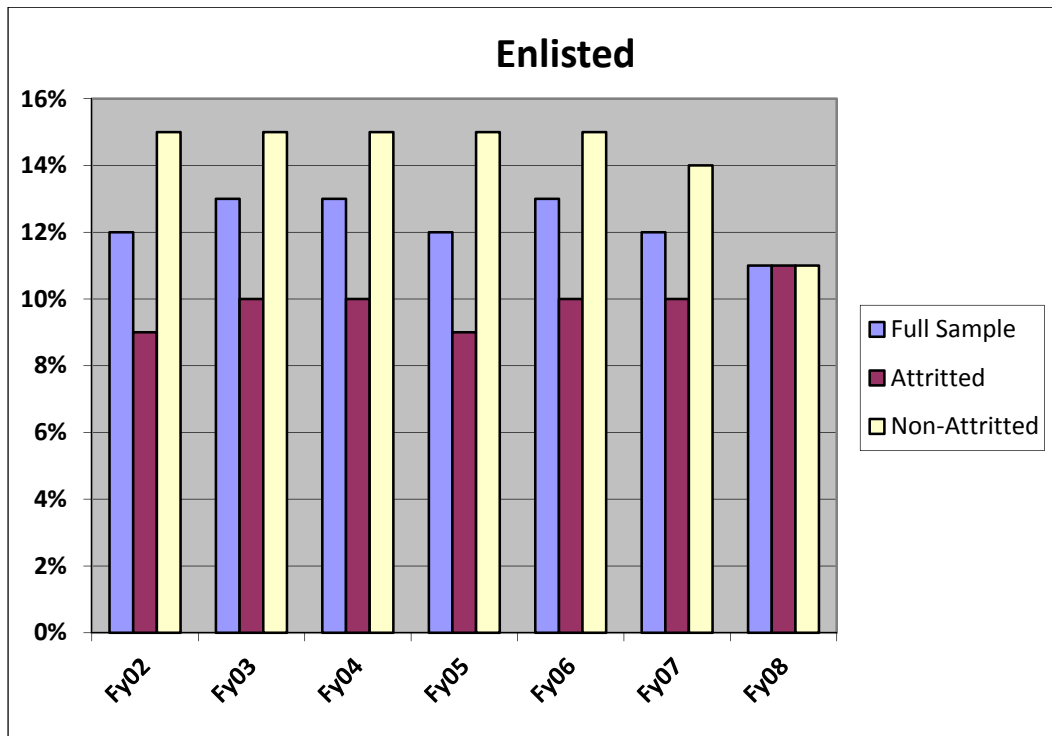


Figure 33. Cohort Percentages of Enlisted Personnel

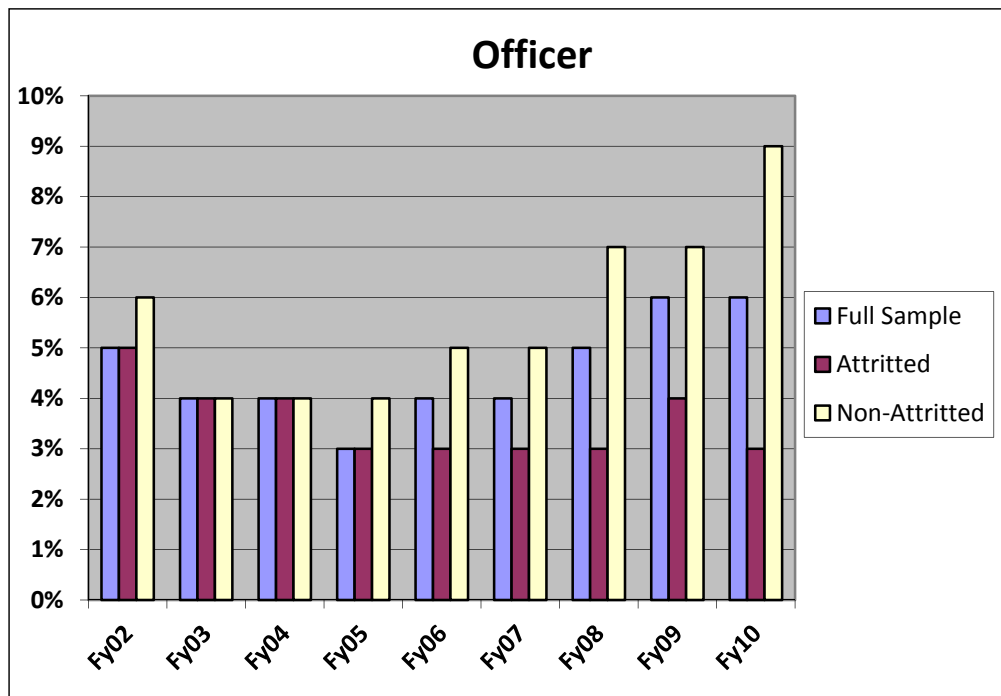


Figure 34. Cohort Percentages of Officers

Fiscal year cohorts provide consistent results for both the enlisted personnel and the officers. All the percentages with a few exceptions for both populations for the non-attributed groups are higher than the attributed group by varying amounts between 6 and 1 percentage points. The exceptions also distributed equally between attributed and non-attributed groups rather than having percentages associated with higher attrition probabilities. This finding concludes that for each year more Marines are kept than attributed. Another finding for both populations is the behavior of the Marines from the year 2001 through 2010. While the percentages for the attributed and non-attributed groups for the enlisted personnel are stable for the beginning years, the percentages of the non-attributed groups decrease while the same number increases for attributed groups towards the end. However, for the officers the situation reverses. Although the percentages of non-attributed groups are relatively small in the beginning years, these numbers increase as time passes. These results signify that the attrition probability increases with the time for enlisted personnel, especially for the last fiscal years, while the same probability decreases for the officers.

C. SUMMARY

This chapter presents the descriptive statistics of variables. According to the findings in this chapter, being married is one factor which decreases the attrition probability in the SMCR. Besides marital status, age and having dependents are other factors which decrease the attrition probabilities for demographic category. Another significant result for this category is the finding that officers have considerably higher degrees of education than the enlisted personnel, as expected. Consistent with the literature, findings for hometown are not significant for this study either. But the unemployment rate numbers suggest that as unemployment rate increases, the attrition probability decreases as response. The findings for the AFQT scores are different for officers and enlisted personnel. While higher AFQT scores increases the attrition probabilities for officers, they decrease the same probabilities for the enlisted personnel. Having waiver and having higher Pro/Con marks are other factors which reduce the attrition probability for the enlisted personnel. For the military characteristics having a mid-rank for the enlisted personnel and having a senior rank for the officers decrease the

attrition probability as well. Finally, it is important to note that the attrition probability increases for the enlisted personnel as we move away from the FY01, while the same probability decreases for the officers.

However, descriptive statistics in this chapter give a superficial understanding of factors that affect attrition and further analysis are needed to reach valid findings about attrition behaviors of the Marine Reservists in the SMCR. By using multivariate models and assessing the effects of the independent variables, one can better determine the causes of attrition.

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V. MULTIVARIATE ANALYSIS AND RESULTS

A preliminary analysis based on only summary statistics does not provide sound and satisfactory results to answer the questions of this study. This chapter will introduce and discuss the models which are employed in this thesis to answer all of the questions of this study. Also the results of the multivariate models will be provided and discussed in detail in this chapter.

A. MULTIVARIATE FRAMEWORK

All the multivariate models we use in this study are probit regressions. This model is one of the most suitable models to analyze the binary dependent variables such as attrition. If a linear probability model is used for attrition, the probability that a Marine Reservist will attrit may not be between 0 and 1, according to the results. All the models which are employed in this study to explain the attrition behaviors of the Marine Reservist are a variation of the multivariate sample model which is depicted in the following equation:

$$P(attrition=1|X) = f(\beta_0 + \beta_1(\text{Demographics}) + \beta_2(\text{Ability and Aptitude}) + \beta_3(\text{Military Characteristics}) + \beta_4(\text{Geographic Characteristics}) + \beta_5(\text{FY Cohorts})) \quad (1)$$

The probit models used in this study provide the attrition probabilities of each enlisted Marine and officer reservists in the SMCR units based on the independent variables described in the previous chapters. These models will enable the opportunity to estimate the magnitude of change of the attrition probability for Marine Reservists by changing a specific independent variable one-unit while holding the all other independent variables constant.

B. MODELS AND RESULTS

This study will use two different multivariate models for the enlisted personnel and officers. In this section we present and discuss each model separately. The same steps and processes are followed for both of the models. The independent variables included in the models are presented in Table 7.

Table 7. Independent Variables by Base and Regression Groups

Category	Enlisted		Officer	
	Regressed	Base Group	Regressed	Base Group
Demographics				
Gender	Female	Male	Female	Male
Race	White	Non-white	White	Non-white
Marital Status	Married Divorced	Single	Married Divorced	Single
Dependents	One or More Dependents	No Dependents	One or More Dependents	No Dependents
Age	Age		Age	
Education	Above High School Graduate	High School or Below Graduate	Above High School Graduate	High School or Below Graduate
Ability and Aptitude				
AFQT Scores	AFQT score		-	-
PFT Scores	1 st Class Score 2 nd Class Score	3 rd Class Score	1 st Class Score	2 nd Class Score 3 rd Class Score
Waivers	Having Any Waivers	No Waiver	-	-
Military Characteristics				
Rank	Lance Corporal (E3) Corporal (E4) Sergeant (E5)	Private First Class (E2) and below Staff Sergeant (E6) and above	Chief Warrant Officer 2 (W2) Chief Warrant Officer 3 (W3) Chief Warrant Officer 4 (W4) Chief Warrant Officer 5 (W5) First Lieutenant (O2) Captain (O3) Major (O4)	Warrant Officer (W1) Second Lieutenant (O1)

Category	Enlisted		Officer	
	Regressed	Base Group	Regressed	Base Group
			Lieutenant Colonel (O5) Colonel (O6)	
Occupational Specialty	Combat Arms	Support	Combat Arms Aviation	Support
Geographic Characteristics				
Hometown	Midwest East Midwest West Mid Atlantic South Atlantic South East South East Central West Mountain West Pacific	New England	Midwest East Midwest West Mid Atlantic South Atlantic South East South East Central West Mountain West Pacific	New England
Unemployment Rate	Unemployment Rate		Unemployment Rate	
Fiscal Year Cohorts	FY03 FY04 FY05 FY06 FY07 FY08	FY02	FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10	FY02

Table 7 presents independent variables in two categories using different columns. First column provides the independent variables which are used in the multivariate model. The control group, which will be used to compare the effects of the variables in the regression, is presented in the second column. Because the number of Marines who have the rank of Warrant Officer (W1) for officers and E6 and above for enlisted personnel and the individuals who have the 2nd class marks for PFT test are very limited for the officer population, these categories are added to base group for the regression.

Also, the AFQT variable for the officers has 3,920 missing values which account for the 72% of the entire data. To prevent these missing values from wasting that much of the data, the AFQT variable is excluded from the model for officers.

For the region variables in the models, New England is chosen to be the control group for comparison with the other regions because the New England region is known to have the most educated population in the United States⁹⁶ and is consequently considered to have the lowest attrition probability among the nine regions.

1. Hypothesized Effects of Variables on Attrition

We hypothesize that the independent variables we include in the models in this study are correlated with the attrition behaviors of the Marine reservists in the SMCR. Based on the previous studies and literature review, these expected effects are depicted in Table 8. The sign “-” means that the relevant variable is hypothesized to be negatively correlated with attrition. Alternatively, the sign “+” means that the variable is expected to be positively correlated. For example, being female is hypothesized to be negatively correlated with attrition probability. Other variables can be interpreted likewise.

⁹⁶ Herschelman, “United States Marine Corps Reserve,” 44.

Table 8. Hypothesized Effects of Independent Variables

Category	Variable Description	Variable	Hypothesized Effect
Demographics	Gender	Female	-
	Race	White	-
	Marital Status	Married	-
		Divorced	+
	Dependents	One or More Dependents	+
	Age	Age	-
	Education Level	Above High School Level	-
Ability and Aptitude	AFQT Scores	AFQT Score	-
	PFT Scores	1 st Class Score	+
		2 nd Class Score	+
	Waivers	Having any waivers	-
Military Characteristics	Rank	E3 through E6	+
		W2 through W4	+
		O2 through O6	+
	Occupational Specialty	Combat Arms	-
		Aviation	+
Geographic Characteristics	Hometown	All regions except New England	-
	Unemployment Rate	Unemployment Rate	+
Fiscal Year Cohorts	Fiscal Year Cohorts	FY03 though FY10	-

2. Model for Enlisted Personnel

a. *Introduction of the Model*

The goal of this model is to examine and identify the causes of first-term attrition and the magnitude of these factors for the enlisted personnel in the SMCR. The data for this model includes 42,020 observations. Two models for the enlisted personnel are identified initially. While the first one included the Marine reservists whose PEBDs are before 2001 and after 2008, the second model was dropped these data. The first model is called “full sample model” and the second model is called “reduced model” to prevent the confusion. Then, two models were compared based on the criteria explained in Table 9. The results of the comparison suggests there is significant change in the parameters mentioned previously and the reduced model which is thought to best reflect the intended population’s characteristics is used to predict the attrition behaviors of the enlisted Marines in the SMCR. Table 9 presents the comparison of both models.

Table 9. Comparison of Models for Enlisted Personnel

Criteria	Reduced Model	Full Sample Model
Number of Observations	16,420	48,559
R^2	0.42	0.41
Attrition Rate	44%	69%
Misclassification Rate	17%	16%

Because the observations which have the PEBD before 2001 and after 2008 are deleted from the data set, the reduced model includes fewer observations than the full sample model. Though this fact may seem disadvantageous for the reduced model, in fact it represents the population which this thesis aims to examine. The full sample model includes the enlisted Marines between the years 2009 and 2014. But these individuals do not have the chance to reach the end of the six-year period since the data ends at 2014. Hence, these enlisted Marines are considered as attrition by the model, because they have

fewer observations than six in the data set. As a result, regression group for the attrition variable, which should include only attrited Marines, includes non-attrited Marines also and this heterogeneous composition is compared with the non-attrited group. In other words, the Marines who should be in the base group are included in the regression group. This situation is obvious when the attrition rates of both models are compared. It is 44% for the reduced model and 69% for the full sample model. As explained in the first chapter, the attrition rate for the enlisted personnel is around 50% and this fact warrants the claim that reduced model is better at reflecting the attrited individuals in the data set. In short, though the full sample model includes more observations than the reduced model, it cannot distinguish the attrited enlisted Marines than the non-attrited ones and this creates considerable bias for the full sample model.

R^2 is the amount of the change in the dependent variable which is explained by the model. For example, 42% for the reduced model means that approximately one third of the changes in the attrition of enlisted Marine Reservists in the SMCR are explained by this model. Since the aim of this study is to explain the causes of attrition for the Marines in the SMCR, high rates of R^2 is a very important feature of the models which will be employed in this study. So, we can say that the reduced model is superior to the full sample model, considering the higher R^2 rate, although the difference is very small. However, one should keep in mind that by adding extra variables, the R^2 rate can be increased. So, when comparing two models, we should be cautious about the R^2 rate.

Finally, we discuss prediction accuracy of both models before we decide which model to use. The misclassification rate is found to be 17% for the reduced model while the same number is 16% for the full sample model. Hence, we can conclude that none of the models have superiority over the other one based on the prediction accuracy.

In summary, we can conclude that the reduced model is superior to the full sample model though it includes fewer observations and has slightly less prediction accuracy. Because, it represents the population better and has slightly higher R^2 rate. Based on these findings, the reduced model is considered to be the best model to predict the attrition behaviors of the enlisted personnel in the SMCR and will be used in the multivariate models in the following sections.

In summary, the reduced model is superior to the full sample model though it includes fewer observations. It represents the population better, has higher R^2 rate and prediction power and less insignificant independent variables. Based on these findings, the reduced model is considered to be the best model to predict the attrition behaviors of the enlisted personnel in the SMCR and will be used in the multivariate models in the following sections.

b. Results of the Model

Appendix B presents the parameters and the marginal effects of each independent variable for the model. There are 32 independent variables in the model and 21 of them are significant to the 95% level. As stated in the previous section, there are 16,420 observations in the regression, and the R^2 rate of the model is 42%.

Because the dependent variable, which is attrition, is binary, marginal effects are used to explain the findings of the model for the enlisted personnel. At this point, it is important to keep in mind that when explaining the effect of an independent variable, other variables are held constant at their mean values.

The independent variables in the model were tested and no multicollinearity was detected between the variables which need to be addressed.

3. Model for Officers

a. Introduction of the Model

The aim of this model is to examine and identify the causes of first-term attrition and the magnitude of these factors for SMCR officers. The data consists of 5,410 observations. As is the case for the enlisted personnel, two models are identified for the officers initially. While the first model includes all the observations in the data, the second model does not include the officers whose PEBDs are before 2001 and after 2010. The first model is called as “full sample model” and the second model is called as “reduced model.” Then, both of the models are regressed by using all of the usable variables achieved from the data. Two models are compared with each other by considering the criteria described in Table 10. Results of the models showed that there

are significant differences between the models and according to the parameters, reduced model is chosen to predict the causes of officer attrition in the SMCR.

For the officers' model, AFQT scores excluded from the regression. There were 3,920 missing AFQT scores out of 5,410 observations, which accounts for the 72% of the data. This large amount prevents to infer meaningful results about AFQT variables from the data and by reducing the observation number, it does not reflect real values of other variables. Table 10 presents the comparison of both models.

Table 10. Comparison of Models for Officers

Criteria	Full Sample Model	Reduced Model
Number of Observations	4,014	504
R²	0.40	0.54
Attrition Rate	57%	49%
Misclassification Rate	20%	15%

The original data contains 5,410 SMCR officers, which is pretty small for an attrition study, when compared with the literature. Because of the missing values, this number drops to 504 for the reduced model which is too low and drops to 3,860 for the full sample model, which is still not enough but the best out of two.

The R² of the reduced model is higher than the rate of full sample model by 14 percentage points. However, this value is related with observation number. The trails while building models suggested that the models with lower observation number have higher R²s. That is why the fact that reduced model has only 504 observations contributes to higher R². This deemphasizes high R² of reduced model.

First-term attrition rate in the previous studies are around 50%. The attrition rates of the models are 57% for full sample model and 49% for reduced model. These rates are not only close to each other but also close to literature, that is why one cannot suggest one model is superior to other by looking at attrition rates.

Finally, misclassification rates of the both models are compared. Misclassification rate is found to be 15% for the reduced model and 20% for the full sample model which means that there is no significant difference between two models.

In summary, the full sample model is considered to be superior to the reduced model because it has more observations and represents the officer population better, although it has a lower R^2 and lower prediction accuracy. Based on these findings, the full sample model is considered to be the best model to predict the attrition behaviors of the SMCR officers and is used in the multivariate model.

b. Results of the Model

Appendix C presents the parameters and the marginal effects of each independent variable for the model. There are 36 independent variables in the model and 25 of them are significant to the 95% level. As stated previously, there are 4,014 observations in the regression and R^2 rate of the model is 40% which means more than one third of the changes in the attrition is explained by this model.

Because the dependent variable which is attrition is binary, marginal effects are used to explain the findings of the model for the officers. At this point it is important to keep in mind that when explaining the effect of an independent variable, other variables are held constant at their mean values.

The independent variables in the model were tested and no multicollinearity was detected between the variables which need to be addressed.

4. Analysis of the Results

This section presents and discusses the findings of the models based on the five categories explained in previous chapters. Also, we compare the findings for the officers and enlisted personnel to identify the different effects of each variable on the attrition behaviors of each group. The possible reasons for the direction and the magnitude of the effects of variables will also be provided. However, the primary aim of this study is to determine the causes of attrition rather than explaining the reasons of them, so further and

more detailed research must be conducted to explain the actual results of each variable in this study.

a. Effects of Demographics on Attrition

Both models provide insignificant results for the gender effect on the attrition probability. Based on these results, it is not possible to make conclusions about being female or male on the attrition behavior the Marine Reservists. This finding may be the result of policies which are employed by the Marine Corps to employ more females in the units.

Another variable which yields insignificant results is *white*. The literature concludes that blacks are more likely to attrit than whites. However, this situation has changed in recent studies, and recent results have insignificant and inconsistent findings for the race category. This situation may be the result of the atmosphere which was created by 9/11 or GWOT in American society and the recovering conditions of the U.S. economy. These events may fill the economic and demographic gaps between the racial groups in the U.S. and the race variable may have lost its importance as a determinant of attrition.

Married enlisted personnel are more likely to attrit than single reservists according the results of the model. The marginal effect of married variable is 0.131 with the 99% significance level. This fact means that married enlisted Marines are more likely to attrit than single enlisted Marines by 13.1 percentage points. Being divorced also increases the attrition probability for the enlisted Marines by 16.5 percentage points with the same significance level. Considering the 44% attrition rate for the enlisted personnel, we can say that marital status variables have significant effect on the attrition behaviors of the Marine Reservists. The finding about the married Marines is consistent with the hypothesized effects for marital status. Being in the RC requires the Marines to participate in the monthly and annual trainings. Furthermore, there is always possibility to be deployed for the Marines in the RC and this situation creates more problems for the married Marines. These consequences of being a member of RC affects the married Marines more than the single ones. Contrary to literature, divorced Marines are found to

have more probability to attrit than singles also. Considering the emotional and monetary problems of being divorced, this result can be explained more easily. But it is difficult to make conclusions about the divorced Marines in this study because they constitute only the 3% of the entire data. The researches in the literature also have the same problems.

For officers, the situation reverses. Married officers are less likely to attrit than single ones. The marginal effect of this variable is 0.363 with the 99% significance level. That means, contrary to enlisted personnel, married officers less likely to attrit than single ones by 36.3 percentage points. Similarly, being divorced also decreases the attrition probability for officers by 28 percentage points with 99% significance level. Because the attrition rate is 57% for the officers, these variables also have significant effect on the attrition decisions of the officer Marines. The average age for the married enlisted personnel is 26 years and is 40 years for the officers. Because the married officers are approximately 15 years older than enlisted personnel, they are more mature and their decisions tend to be more accurate. So, when they decide to join the RC, they know what they will face and how they will react. For example, they know that they may be deployed or mobilized and that the annual trainings may affect their lives, and they make their decisions accordingly. Hence, they are disappointed less, and attrition probabilities are lower for them. Although this may be an explanation for the adverse effects of marital status on both populations, further and more detailed research is needed to find the actual reasons of this difference.

Having one or more dependents is positively associated with the attrition probabilities for the enlisted personnel. The marginal effect of having dependent is 0.097 with the significance level of 99%. So, if an enlisted Marine has one or more dependents, the probability of attrition for that individual is 7.5 percentage points less than the enlisted Marines who have no dependents. The dependent effect is also considerable for attrition but not as significant as the marital status variables. This finding is consistent with the literature and hypothesized effect. Having dependents is an additional burden and responsibility for the people. While Marines without dependents may only consider their own future, the Marines who have dependents have to consider the fate of their

dependents also. Hence, this situation makes it harder for Marines with dependents to leave the SMCR and give up the additional income from being a Marine.

However, the effect of dependent on attrition probability for the officers is negative. The marginal effect of dependent variable is 0.32 with the 99% significance level. That means having a dependent increases the attrition probability of an officer by 32 percentage points. This effect also a significant effect for the attrition probability of the officers and the magnitude of this effect is similar to that of the marital status variables. The rate of officers who have above high school education is 94% while the same rate is 6% for the enlisted personnel. Based on this fact, it is possible that officers have better paying jobs than enlisted personnel and, if they have dependents, they can more easily give up their position in the RC to spend time with their dependents and enjoy their leisure time since they can compensate the loss caused by leaving the RC with their civilian job.

Age is another factor for enlisted personnel that is associated with lower attrition probability. The marginal effect of age is 0.057 for the enlisted Marines in the SMCR with the 99% significance level. Considering that the average age is 25 for the enlisted Marines, each additional age above 25 decreases the attrition probability of that individual by 5.1 percentage points. But compared to other variables and the attrition rate for enlisted personnel, we can conclude that age has a relatively small effect on attrition. The finding about age contradicts the hypothesized effect. Literature suggests that because people get more mature with age, they have a greater chance to find better working opportunities in the civilian markets and that increases the attrition probability. However, as you spend more time in a job, you gain experience specific to that job and usually most of this experience is non-transferrable to other areas. Also if an individual is relatively older, it is possible that the employer will not be able to employ that person as long as a younger one and that decreases the chances of elder enlisted Marines to find satisfying jobs in the civilian markets. Furthermore, as a person stays longer in a job, the pay increases in accordance with the person's tenure. Also, older people have bigger families to look after, kids in college, and so forth, so they need more money than the younger people and do not want to lose the additional income that the SMCR affiliation

provides. These facts make it harder for the relatively older people to quit their current jobs, or the SMCR in the case of our study, than for the younger individuals.

For officers also, age decreases the probability of attrition. The marginal effect of age is 0.011 with 99% significance level, which means that each additional year decreases the attrition possibility of the officers by 1.1 percentage points. But this effect is also very small compared to other variables in the officers' model. In fact, the age variable has the smallest effect on the attrition probability for the officers.

For enlisted Marines, higher education levels are associated with a higher attrition probability. The marginal effect of the variable for the Marines who have above high school level of education is 0.31 with the 99% significance level. So, having education above the level of high school increases the attrition probability of the enlisted Marines by 31 percentage points. Because the attrition rate is 44% for this population, education level has great effect on the attrition decisions of the enlisted Marines. This finding is also not consistent with the hypothesized effects. It was decided that higher educated Marines will be more loyal to their jobs and make more accurate decisions and predictions about their lives, so their attrition probabilities would be less. However, the U.S. economy is recovering and the unemployment rates are decreasing steadily. This situation makes it easier for educated people to find better jobs in the civilian markets. Marines in the SMCR can work in civilian jobs while participating in trainings in their units. However, as they make more money in the outside, they will no longer want to lose their leisure time by participating in trainings in the weekends. Also while in the SMCR, they always have the probability of being deployed overseas. Deployment will cause them to lose significant income from their civilian jobs. Besides, if they are making satisfying money in their civilian jobs, they will not want to experience the problems of deployment. These facts explain the negative effect of education on the attrition probability of the enlisted Marines in the SMCR.

Education increases the attrition probabilities of officers also. The marginal effect of the variable for the officers who have above high school education level is 0.179 with 99% significance level. Hence, compared to the officers who have high school and below level, these officers are more likely to attrit by 17.9 percentage points for the reasons

mentioned for the enlisted personnel. Based on the average attrition rate of 57% for the officers, we can say that education has moderate effect on the attrition decisions of the officers.

b. Effects of Ability and Aptitude on Attrition

According to results of the model for enlisted personnel, higher AFQT scores decrease the attrition probability of the Marine Reservists in the SMCR. But the magnitude of the change is very small compared to mean attrition rate for the enlisted personnel. In fact, among the independent variables, AFQT score has the lowest effect on attrition probability for the enlisted Marines. The marginal effect of the variable for the above average AFQT scores is 0.001 with the 99% confidence level which means one additional AFQT score decreases the attrition probability by 0.1 percentage point. This result contradicts to the hypothesized effects for AFQT variable. So, it can be concluded that the Marines who have high scores from the AFQT scores are more loyal to the USMC RC and they assume the military lifestyle more than other reservists. Although this suggestion contradicts the theory that the U.S. economy is recovering and that there is a higher demand in the civilian sector for educated people, the AFQT scores neither reflect the education level of the individuals nor present the real condition of the people when they attritted or completed their contracts since AFQT test is taken before admission to the U.S. military. So the AFQT scores of the individuals in their first records are used for the enlisted model which reflects the condition of the enlisted Marines when they entered the military. Besides, it is possible that regardless of their education status, people may get high scores to join the military if they really want to be a soldier and stay in the military. However, one should keep in mind that the effect of the AFQT score on the attrition probability is almost insignificant in terms of magnitude.

PFT is another category the findings of which contradict to the hypothesized effects. Having a PFT 1st and 2nd class scores rather than 3rd class increases the attrition probability of the enlisted Marines. The marginal effects of these variables are 0.186 and 0.082 consecutively with 99% significance level. The interpretation of these numbers is that the Marines who have the PFT score of 1st and 2nd class are more likely to attrit than

the Marines who have 3rd class PFT scores by 18.6 and 8.2 percentage points. As can be seen from the coefficients, the probability increases in accordance with the scores. This finding is another evidence that the more able and educated people have better opportunities in the civilian markets and as the economy gets better the attrition rates for these Marine reservists increases. Compared to mean attrition rate for the enlisted personnel which is 44%, we can conclude that 2nd class scores have relatively low effect on attrition while the 1st class scores have more significant effect.

For the officers, however, 1st class PFT scores are associated with lower attrition probabilities. The marginal effect for this variable is 0.109 with 99% significance level which means having 1st class score for PFT for an officer decreases the probability of attrition by 10.9 percentage points. Because the attrition rate is 57% for the officer Marine Reservists, PFT scores have relatively low effect on the attrition behavior of the officers. Contrary to enlisted personnel and in accordance with the literature, high PFT scores may signify dedication of officers to their duty while this may not be the case for the enlisted personnel. Because the average age for the enlisted personnel is approximately 10 years younger than the officers and the standards are higher for younger individuals to get 1st Class marks in the PFT, these physically more able individuals may be demanded more in the civilian markets, especially for jobs requiring human power. So while the 1st class PFT score is a negative factor for enlisted personnel, it decreases the attrition probability for officers in the SMCR.

Since Pro/Con marks have statistically insignificant results because they have high P values, the last variable under this category is the waiver and, contrary to the hypothesized effect, having a waiver has positive effects on the attrition behaviors of the enlisted Marine reservists. The marginal effect of the waiver variable is 0.029 with the significance level of 95%. So, having any kind of waiver decreases the attrition probability of the Marine Reservists by 2.9 percentage points. It is possible that these Marines had problems finding jobs in the civilian sector and after being admitted to the military with a waiver, they do not want to lose their current status in the USMC. That is probably why the enlisted Marines with waivers are less likely to attrit than the Marines with no waivers. However, compared to other variables and the mean attrition rate for the

enlisted personnel, waiver is among the variables with the lowest effect on attrition probability.

c. Effects of Military Characteristics on Attrition

Rank is associated with lower attrition probability for the enlisted Marine Reservists in the SMCR except E5s. The marginal effects of rank variables are 0.234, 0.723, and 0.355 for the Marines who have the rank of E3, E4, and E5, successively, with the 99% significance level. So Marines who have ranks of E3 and E4 have less probability of attriting than Marines who have a rank of E2 and below by 23.4 and 72.3 percentage points. This finding is consistent with the hypothesized effect for this variable. The Marines who enjoy the military lifestyle tend to stay in the military longer periods than those who do not enjoy and they are promoted in the Marine Corps. However, having the rank of E5 increases the attrition probability by 35.5 percentage points. This may result from the fact that more experienced Marines are in high demand in the outside and some of them want to evaluate these opportunities in the later ranks. It is important to note that, together with education category, rank variables have the greatest effect on the attrition behavior of the enlisted reservists.

Similar to enlisted Marines, rank is associated with lower attrition probability for the officers in the SMCR. Compared to Second Lieutenant (O1), all other ranks have less probability to leave the SMCR by varying percentage points between 99.5 (for Captain) and 78.6 (Chief Warrant Officer 5) with the significance level of 99%. Though this is the case for the officers, there is no steady increase or decrease through the ranks for officers. But similar to enlisted Marines, rank category has the greatest effect on the attrition decision of the officers in the SMCR.

According to the results, being in a combat unit rather than a support one increases the attrition probability for the enlisted Marines. Since there are no enlisted Marines in the aviation units according to the data set, only the combat and support units are compared with each other. The marginal effect of combat unit variable is 0.038 with the 99% significance level. That means the enlisted Marines in the combat units are 3.8 percentage points more likely to attrit than the individuals in the support units. This

finding is also consistent with the hypothesized effects and the literature. Since the conditions in the combat units are demanding and the probability of participating in a combat and being deployed to hostile areas is higher for these units, it is likely that attrition probabilities in these units are higher than the support units. However, the effect of this variable is relatively low compared to other variables and 44% attrition rate of enlisted Marines.

For officers, being in the aviation units increases the attrition probability, while being in the combat units has the opposite effect. The marginal effect for the aviation variable is 0.058 with 95% significance level, while the same number is 0.038 for the combat variable with the 95% significance level. It is possible that officers who are in the aviation units have capabilities that are in high demand in the civilian aviation companies and this fact increases the attrition probability for the aviator officers by 5.8 percentage points. Being in a combat unit, however, decreases the attrition probability by 3.8 percentage points contrary to enlisted personnel. Officers are leaders in the military and this role is assumed only in the combat units. If a person wants to be an officer and lead other Marines in the USMC, that individual should join the combat units to satisfy this goal. Hence, being in a combat unit is associated with lower attrition probability for the officers as opposed to enlisted Marines. But together with age, unit type variables have the smallest effect on the attrition decision of the officers in the SMCR.

d. Effects of Geographic Characteristics on Attrition

For enlisted personnel, only one variable has a statistically significant result and all other marginal effects for region variables are insignificant. The marginal effect of Midwest West region is 0.072 with 99% significance level. That means that enlisted Marines from that region are 7.2 percentage points less likely to attrit than the Marines from New England. The effect of this region is moderate considering the 44% attrition rate of enlisted personnel in the SMCR. Contrary to hypothesized effect, this region is associated with lower attrition probability compared to New England Region. But, since the higher levels of education are found to increase the attrition probability, this result is consistent with the findings of the models in this study.

Similar to enlisted personnel, none of the variables for the region in the model for officers provided statistically significant results. Having insignificant results for regions of the Marines is the general problem for the literature also. Almost all findings about the region for attrition studies are mixed, inconsistent or insignificant.

The unemployment rate is associated with the lower attrition probability for the enlisted personnel and the marginal effect of this variable is 0.038 with the significance level of 99%. Hence, the interpretation for this variable is one point increase in the unemployment rate of the hometown of the Marine, decreases the attrition probability of that individual by 3.8 percentage points. This result is consistent with the hypothesized effects and the literature. High unemployment rates signify that the economy is in recession and it is hard to find a job in the civilian sector. So, enlisted Marines in the SMCR decide to stay in the RC and that decisions decrease the attrition probability in the SMCR. However, one should keep in mind that considering the magnitude of the marginal effect, this variable has relatively small effect on the attrition probability of the Marine Reservists. For officers, the unemployment variable did not provide statistically significant results since the P value is greater than 0.05.

e. Effects of Fiscal Year Cohorts on Attrition

Lastly, the effects of joining the RC in different years will be discussed in this section. All the marginal effects for the FY03 through FY08 for enlisted personnel varies between 12.4 and 19.6 and are associated with lower attrition probability compared to the FY02 with significance levels of 99%. This result contradicts the hypothesized effect for this variable. It is possible that during the following years after 9/11 and the declaration of GWOT, patriotism and the rage of the U.S. society were high, and this situation was reinforced with new events and threats in the world. This situation in the world and United States kept the attrition rates low for the years following 2002. Although the coefficients change as they move away from the FY03, they still have positive effects on the attrition rates. The magnitude of the marginal effects suggests that these variables have a considerable effect on the attrition rates of the enlisted Marines compared to 44% attrition rate.

For the officers, the results are the same. All the years after 2002 are associated with lower attrition probabilities with varying marginal effects between 16.5 and 64.6, which means attrition probabilities are lower for these years. Further, the marginal effects are increasing with time, possibly for the reasons explained for the enlisted personnel. Fiscal year cohort variables also have a significant effect on the attrition behavior of the officers compared to the 57% attrition rate.

C. SUMMARY

This chapter introduces the models for the officers and enlisted personnel in the SMCR and explains them in detail. Also, it presents and discusses the findings of the each model. The model for the enlisted personnel suggests that being married or divorced and having above high school level of education are related with higher attrition probability for the enlisted Marines in the demographics category. Similarly, having high scores for the PFT and being in a combat unit increase the attrition probability. On the other hand, having a dependent, higher age, higher AFQT scores, having a waiver, being in the higher ranks, and unemployment rate are found to decrease the attrition probability for the enlisted personnel in the SMCR. The magnitude of the coefficients suggests that ranks and education has the greatest effect on the attrition behavior of the enlisted Marines while the AFQT scores and waiver have the lowest effect.

The model for the officers also provided some interesting findings about the attrition behaviors of the Marine Reservists. For example, having a dependent, having education level above high school, and being in an aviation unit are the factors which increase the attrition probability. But being married, higher age, having 1st class PFT scores, being a higher rank, and being in a combat unit are found to decrease the attrition probability for the officers. For the officers also, rank has the greatest effect on the attrition probability while the age and the unit type variables have the lowest effects.

The comparison of models with each other suggested that some variables have different effects on each population. For example, being married is associated with higher attrition probability for the enlisted personnel while it decreases the attrition probability of officers. Higher PFT scores and being in a combat unit are other variables which have

the opposite results for each population. Similarly, having a dependent decreases the attrition probability of the enlisted Marines while it has the opposite effect for the officers.

Not all of the variables were found to have significant effects on the attrition probability as hypothesized in this chapter. For example, race, hometown, and gender categories did not provide significant results for both models. Further, the unemployment rate for officers has statistically insignificant results, while the Pro/Con marks have the same problem for enlisted personnel.

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VI. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. SUMMARY

The primary aim of this research is to identify the determinants of first-term attrition for enlisted personnel and officers in the SMCR. Also, this study aims to find how first-term attrition factors differ between officers and enlisted personnel. Numerous variables are examined in this study to find causes of attrition. These variables are categorized under five headings: demographics, ability and aptitude, military characteristics, geographic characteristics, and fiscal year cohorts.

As discussed in the first chapter, attrition is a serious problem for the Marine Corps. Attrition through losses of experienced personnel increases costs and has an adverse effect on Marine Corps readiness. The research specifically examines the SMCR portion of the RC which is structured under the Ready Reserve/SelRes. The majority of the SelRes are affiliated with the units in the SMCR. Additionally, Marine Reservists conduct their monthly and annual trainings in SMCR units. Contrary to other Ready Reserve structures which include individual Marines, the SMCR consists of regular units. Because most of the enlisted Marines are contracted with 6x2-year type contracts, this group was selected as the study population. The same situation is true for officers' 4x4-year contract types. The attrition rate for enlisted personnel is 44%, while it is 57% for officers in the SMCR.

The data for the enlisted personnel and officers in the SMCR was provided by Headquarters Marine Corps, Manpower & Reserve Affairs, and the unemployment rates for the years 2001 through 2014 were obtained from the Bureau of Labor Statistics website. The data for both populations include annual snapshots of each Marine Reservist. The number of observations is approximately 500,000 for enlisted personnel and 50,000 for officers. The data is cleaned, coded, and reshaped to keep only the first and last observations for each Marine. Finally, according to the nature of the variable, the first or last information for each variable category is retained to reach only one record for every individual in the data set. These steps made it possible to use each data set in the

multivariate models and provided the basis for determining whether the individual stayed in the SMCR six years or more to create the dependent variable, which is attrition.

As explained in detail in Chapter V, two separate models were created for the enlisted personnel and officers. To reach final models for each population, two draft models were initially identified. The first model was a reduced model which only included enlisted Marines who entered the RC after 2001 and before 2008, and before 2010 for officers. The second model is a full sample model that included all Marines in the data set. These two models were compared with each other and finally a reduced model for enlisted personnel and full sample model for officers were found to be the best model to predict attrition probabilities for each population.

B. CONCLUSIONS AND RECOMMENDATIONS

1. What Factors are Correlated with First-Term Attrition for Reserve Enlisted Marines?

a. Conclusion

Most of the variables for the enlisted personnel were found to have significant effects on the attrition behavior of the Marine reservists. The demographics for being married or divorced and having education above high school level are the factors which increase the attrition probability while having dependent and age decreases it. The findings about being divorced, age, and education level differ from the literature. Divorced Marines constitute a little portion of the data similar to other studies. So, it is not appropriate to make conclusions based on the findings for such a community. The differences for age and education level are assessed to stem from the change in the U.S. economy and the different decisions by demographic groups. Compared to other variables and the 44% attrition rate for the enlisted personnel in the SMCR, we can conclude that age has the lowest effects on the attrition probability while the effect of education is the highest and marital status and dependents have moderate effect on attrition probability for the demographics category.

For the ability and aptitude, higher AFQT scores and having a waiver are associated with lower attrition probabilities, but higher PFT scores were found to increase

attrition probability. For this category, results about AFQT and PFT scores contradict the literature. These results are also considered to be associated with the changing dynamics in the U.S. economy. But, one should keep it in mind that AFQT scores do not reflect the actual and current ability and aptitude of individuals. AFQT scores and having a waiver have low effects on the attrition probability for the enlisted personnel while the PFT scores have a moderate effect. In fact, AFQT scores have the lowest effect on attrition probability of enlisted personnel among the all variables in the model.

Rank and the unit type are two subsections under the military characteristics category. Higher ranks have a positive effect on the attrition probability, but being in a combat unit was found to increase the attrition probability. While the unit type variables have relatively low effect on attrition behavior of enlisted Marines, rank has the greatest effect on the attrition probability among the all variables in the model.

For geographic characteristics category, higher unemployment rates are found to decrease the attrition probability of Marine Reservists but its effect is relatively low compared to other variables.

The last category is the fiscal year category, and all the years after 2002 were found to decrease the attrition probability for the enlisted personnel though there is no increase and decrease throughout the years. Fiscal year cohort variables also have a moderate effect on the attrition probability of the enlisted Marines in terms of the magnitude of their marginal effects.

b. Recommendations

Some findings had greater effects on attrition probability while others were negligible or insignificant. Hence, the recommendations in this section only include areas which have larger effects for cost efficiency. The largest effect belongs to education level, above high school level graduates, for the enlisted personnel. Also, having high PFT scores have significant negative effect on attrition probability. M&RA should establish policy to keep these more able enlisted personnel in the RC. Being married and divorced are also significant factors that increase the attrition probability. When recruiting personnel, the Marine Corps should target single individuals to decrease the

attrition probability. Finally, as long as enlisted personnel stay in the efficient range, Marine Corps may enlist older individuals in the RC.

2. What Factors are Correlated with First-Term Attrition for Marine Reserve Officers?

a. Conclusion

Being married and higher age decreases the attrition probabilities for Marine Officers while having dependents and higher education levels increase the probability. Marital status and having dependents contradict previous findings for the enlisted demographics category. The data attributes the differences between the populations to be caused by the older ages and higher education levels of officers. When compared to a 57% attrition rate for SMCR officers, demographic variables have a moderate or low effect on the attrition probability. For example, age has the lowest effect on the attrition probability while all other variables have moderate effects.

Only the PFT score variable for the ability and aptitude category is included in the model for officers and, as opposed to enlisted personnel, higher PFT scores were found to decrease the attrition probability for this population. This finding is also considered to be the result of older ages of officers. The effect of PFT scores is also low compared to other variables in the model.

For the military characteristics category, higher ranks and being in a combat unit are associated with lower attrition probability while being in an aviation unit increases the attrition possibility. There is an interesting difference between officers and enlisted personnel. While being in a combat unit increases the attrition probability for enlisted personnel, it has the opposite effect for the officers. This difference is assessed to be the result of officers' leadership roles. Rank variables have the greatest effect on the attrition behavior of SMCR officers, but the effects of unit types are assessed to be low.

Fiscal year cohorts are found to decrease the attrition probability for the officers. Besides, increasing marginal effects as they move away from the year 2002 indicate that the attrition probability decreases for the officers as time passes. Fiscal year cohort

variables have a significant effect on the attrition probability of the officers since their marginal effects are close to the officers' attrition rates.

b. Recommendations

The Marine Corps should recruit married officers to decrease officer attrition probability. Since having a dependent and higher education level are significant factors which increase attrition probability, policy-makers should devise policies to keep the officers who have dependents and who have high education levels in the RC. For example, additional bonuses or incentives may be offered to highly educated officers and to the individuals who have dependents.

3. How Do First-Term Attrition Factors Differ between Officers and Enlisted Personnel?

a. Conclusions

Some independent variables included in the models for each population have different effects. For example, being married is associated with a higher attrition probability for enlisted personnel while it decreases the attrition probability of officers. Similarly, having a higher PFT score or being in a combat unit has the opposite results for each population since they are associated with a higher attrition probability for officers and a lower probability for enlisted personnel. However, having dependents has different adverse effects, because it decreases the attrition probability of the enlisted Marines while it has the opposite effect for the officers.

b. Recommendations

Because enlisted personnel and officers are different populations which include different individuals who have different characteristics, their attrition behaviors are different also. So an M&RA policy which decreases the attrition probability in one population may not be useful in the other population. Policy-makers should examine each population based on its own characteristics and employ the policies afterwards.

C. FOR FUTURE WORK

There are some limitations in this study which affect the predictive accuracy of the multivariate models for enlisted personnel and officers. These drawbacks will be explained in this study to provide suggestions to future studies on attrition.

The first limitation is the limited number of observations in the officer data set. While the observation number is 500,000 for the enlisted personnel, this number is only 50,000 for the officer. Once the data is cleaned and coded, only 3,860 observations remained for the multivariate model. Though this number is sufficient to predict results, additional observations in the data set would increase the significance of the results and predictive ability of the model.

Another limitation which affects both models is the identification of the attrition variable. The binary variable for attrition for this study is calculated for each individual by examining the number of observations in the data sets because there was no information about the individuals regarding their attrition status and many data fields included inconsistent values or were left blank. If enlisted personnel and officers have less than six or four observations in the data, respectively, they are considered as attrition. So, future studies should obtain the data exact information about the attrition status or correct and consistent information for the data fields.

This study aims to identify as many causes of attrition as possible. Hence, high R^2 is very important for the multivariate models in this research. The enlisted attrition model is 0.42 and 0.40 for the officer model. Though these numbers are pretty high to explain the causes of attrition, additional variables will increase them even further. These additional variables may include deployment status, unit location, and so forth.

Though this study provides significant and valuable findings for the policy-makers in the USMC, further research and analysis should be conducted to implement or change any policy regarding the manpower issues in the RC.

D. FOR TURKEY

Turkish Armed Forces consists of Army, Navy, Air Force, Gendarmerie, and Coast Guard. There are no Turkish Armed Forces similar to the USMC. Turkish Army and operational units of Turkish Gendarmerie are similar to the USMC in the context of missions, such as fighting on the front line.

The U.S. active military operates in various parts of the world, especially in the Middle East, which is one of the most unstable regions of the world. That is why the U.S. military is thought to be one of the most powerful militaries in the world. The region surrounding Turkey is an unstable region too. Ongoing internal wars in Syria and Iraq, conflicts between Palestine and Israel, nuclear studies of Iran, conflicts between Russia and Ukraine, and tension between Armenia and Azerbaijan affect Turkey. Additionally, Turkey itself also has an ongoing fight against Kurdistan Workers' Party (Partiya Karkeren Kurdistane – PKK) terrorists. That is why Turkey has to maintain a strong military.

The Turkish military has about 675,000 personnel, a large portion of which is composed of officers, noncommissioned officers, and conscripts. Regular officers and noncommissioned officers attend military schools and have a 10-year military service obligation after graduation. Conscripts are Turkish citizens who are fulfilling their 12-month compulsory military service at the age of 20. Other than these personnel, the remaining staff consists of contracted personnel (contract officers, contract noncommissioned officers, contract sergeants, and contract privates).

The Turkish military has emphasized professionalism in recent years and replaced some of the conscript units which fight against PKK with sergeants and privates who are contracted. The compulsory military service for conscriptions has been shortened from 18 months to 12 months gradually. Similarly, Turkey started to recruit contracted officers and contract noncommissioned officers to meet low-rank personnel needs and shortened the compulsory regular officers' and noncommissioned officers' military service from 15 years to 10 years. These changes are part of the steps toward transforming to an all-volunteer force.

The shorter compulsory military service for regular officers and noncommissioned officers, and more contracted personnel has caused attrition to become a more significant problem than it has ever been for Turkey. This study can be beneficial to Turkey to examine attrition utilizing the models from this research with Turkish data.

**APPENDIX A. SUMMARY STATISTICS FOR FULL SAMPLE,
ATTRITTED AND NON-ATTRITTED OF ENLISTED AND
OFFICER RESERVISTS**

Variable	ENLISTED			OFFICER		
	Full Sample	Attritted	Non- Attritted	Full Sample	Attritted	Non- Attritted
Observations	42,020	18,564	23,456	5,410	3,098	2,312
Attrition	0.44	1.00	0.00	0.57	1.00	0.00
	(0.49)	(0)	(0)	(0.49)	(0)	(0)
Gender						
Female	0.05	0.06	0.04	0.04	0.04	0.04
	(0.20)	(0.22)	(0.19)	(0.20)	(0.20)	(0.19)
Male	0.95	0.94	0.96	0.96	0.96	0.96
	(0.20)	(0.22)	(0.19)	(0.20)	(0.20)	(0.19)
Race						
White	0.87	0.86	0.88	0.91	0.90	0.91
	(0.33)	(0.35)	(0.32)	(0.29)	(0.29)	(0.28)
Non-white	0.13	0.14	0.12	0.09	0.10	0.09
	(0.33)	(0.35)	(0.32)	(0.29)	(0.29)	(0.28)
Marital Status						
Single	0.67	0.70	0.65	0.41	0.60	0.16
	(0.46)	(0.45)	(0.47)	(0.49)	(0.49)	(0.36)
Married	0.30	0.27	0.32	0.53	0.36	0.77
	(0.45)	(0.44)	(0.46)	(0.49)	(0.47)	(0.42)
Divorced	0.03	0.03	0.03	0.06	0.04	0.07
	(0.17)	(0.18)	(0.16)	(0.23)	(0.20)	(0.25)
Dependent	0.33	0.29	0.36	0.69	0.60	0.81
	(0.47)	(0.45)	(0.48)	(0.46)	(0.48)	(0.39)
Age	25.13	24.15	25.91	36.68	33.21	41.32
	(3.17)	(3.42)	(2.71)	(8.32)	(7.48)	(7.03)

Variable	ENLISTED			OFFICER		
Education						
HS_grad	0.94	0.94	0.94	0.05	0.03	0.07
	(0.23)	(0.24)	(0.23)	(0.21)	(0.17)	(0.26)
More_HS	0.06	0.06	0.06	0.95	0.97	0.93
	(0.23)	(0.24)	(0.23)	(0.21)	(0.17)	(0.26)
AFQT Scores	65.06	62.45	67.10	81.34	82.15	80.10
	(19.2)	(19.3)	(18.9)	(13.2)	(12.6)	(13.8)
PFT Scores						
Pft_1st	0.70	0.70	0.70	0.92	0.92	0.91
	(0.45)	(0.46)	(0.45)	(0.27)	(0.27)	(0.28)
Pft_2nd	0.26	0.26	0.26	0.08	0.07	0.08
	(0.43)	(0.43)	(0.44)	(0.26)	(0.26)	(0.27)
Pft_3rd	0.04	0.04	0.04	0.01	0.01	0.01
	(0.20)	(0.20)	(0.19)	(0.08)	(0.08)	(0.08)
Pro/Con Marks						
Pros	43.62	43.02	44.07			
	(3.04)	(3.74)	(2.29)			
Cons	43.56	42.88	44.06			
	(3.19)	(4.01)	(2.29)			
Waiver	0.18	0.15	0.20			
	(0.38)	(0.36)	(0.39)			
Ranks						
E2	0.08	0.16	0.02			
	(0.26)	(0.36)	(0.12)			
E3	0.27	0.40	0.17			
	(0.44)	(0.49)	(0.37)			
E4	0.33	0.11	0.49			
	(0.46)	(0.31)	(0.49)			
E5	0.25	0.21	0.28			
	(0.43)	(0.40)	(0.44)			
E6	0.08	0.12	0.04			
	(0.26)	(0.32)	(0.20)			
W1				0.00	0.00	0.00

Variable	ENLISTED			OFFICER		
				(0.05)	(0.06)	(0)
W2				0.03	0.02	0.04
				(0.16)	(0.14)	(0.20)
W3				0.03	0.01	0.05
				(0.16)	(0.10)	(0.21)
W4				0.02	0.01	0.04
				(0.15)	(0.12)	(0.18)
W5				0.01	0.01	0.01
				(0.09)	(0.07)	(0.11)
O1				0.12	0.20	0.00
				(0.32)	(0.40)	(0.02)
O2				0.06	0.06	0.06
				(0.23)	(0.23)	(0.23)
O3				0.30	0.40	0.15
				(0.45)	(0.49)	(0.36)
O4				0.20	0.18	0.24
				(0.40)	(0.38)	(0.42)
O5				0.16	0.08	0.27
				(0.36)	(0.26)	(0.44)
O6				0.07	0.03	0.13
				(0.25)	(0.16)	(0.33)
Occupational Specialty						
Combat_mos	0.44	0.42	0.45	0.35	0.35	0.34
	(0.49)	(0.49)	(0.49)	(0.47)	(0.47)	(0.47)
Aviation_mos				0.18	0.17	0.20
				(0.38)	(0.37)	(0.40)
Support_mos	0.56	0.58	0.55	0.47	0.48	0.46
	(0.49)	(0.49)	(0.49)	(0.49)	(0.49)	(0.49)
Home Location						
Home_midwesteast	0.16	0.17	0.16	0.15	0.15	0.15
	(0.36)	(0.37)	(0.36)	(0.35)	(0.35)	(0.35)
Home_midwestwest	0.06	0.05	0.06	0.06	0.06	0.06
	(0.22)	(0.22)	(0.23)	(0.23)	(0.23)	(0.23)

Variable	ENLISTED			OFFICER		
Home_newengland	0.05	0.05	0.05	0.07	0.07	0.06
	(0.22)	(0.22)	(0.22)	(0.24)	(0.25)	(0.24)
Home_midatlantic	0.14	0.14	0.14	0.15	0.15	0.15
	(0.34)	(0.34)	(0.34)	(0.35)	(0.35)	(0.35)
Home_southatlantic	0.18	0.18	0.18	0.21	0.22	0.21
	(0.38)	(0.38)	(0.38)	(0.40)	(0.41)	(0.40)
Home_southeast	0.06	0.06	0.06	0.04	0.03	0.04
	(0.23)	(0.24)	(0.22)	(0.18)	(0.18)	(0.19)
Home_southeastcentral	0.14	0.14	0.13	0.11	0.11	0.12
	(0.34)	(0.35)	(0.33)	(0.31)	(0.31)	(0.32)
Home_westmountain	0.06	0.06	0.06	0.06	0.06	0.05
	(0.23)	(0.23)	(0.22)	(0.23)	(0.23)	(0.22)
Home_westpacific	0.17	0.15	0.18	0.16	0.15	0.16
	(0.37)	(0.35)	(0.38)	(0.36)	(0.35)	(0.36)
Unemp	7.28	6.78	7.68	6.36	6.24	6.53
	(2.24)	(2.21)	(2.19)	(1.70)	(1.62)	(1.78)
Fiscal Year Cohorts						
FY02	0.12	0.09	0.15	0.05	0.05	0.06
	(0.32)	(0.28)	(0.35)	(0.22)	(0.21)	(0.23)
FY03	0.13	0.10	0.15	0.04	0.04	0.04
	(0.33)	(0.29)	(0.35)	(0.19)	(0.18)	(0.20)
FY04	0.13	0.10	0.15	0.04	0.04	0.04
	(0.33)	(0.29)	(0.35)	(0.19)	(0.18)	(0.20)
FY05	0.12	0.09	0.15	0.03	0.03	0.04
	(0.32)	(0.29)	(0.35)	(0.18)	(0.16)	(0.20)
FY06	0.13	0.10	0.15	0.04	0.03	0.05
	(0.33)	(0.30)	(0.35)	(0.18)	(0.16)	(0.21)

Variable	ENLISTED			OFFICER		
FY07	0.12	0.10	0.14	0.04	0.03	0.05
	(0.32)	(0.29)	(0.34)	(0.18)	(0.16)	(0.21)
FY08	0.11	0.11	0.11	0.05	0.03	0.07
	(0.31)	(0.30)	(0.31)	(0.21)	(0.16)	(0.26)
FY09				0.06	0.04	0.07
				(0.22)	(0.19)	(0.26)
FY10				0.06	0.03	0.09
				(0.23)	(0.18)	(0.29)

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APPENDIX B. RESULTS OF THE ENLISTED PERSONNEL MODEL

VARIABLES	MARGINAL EFFECTS	PROBIT COEFFICIENTS
Independent Variable		
Attrition		
Dependent Variables		
Female	0.040* [0.024]	0.105* [0.062]
White	0.012 [0.015]	0.033 [0.039]
Married	0.131*** [0.025]	0.340*** [0.065]
Divorced	0.165*** [0.035]	0.421*** [0.088]
Dependent	-0.097*** [0.023]	-0.262*** [0.063]
Age	-0.057*** [0.002]	-0.152*** [0.006]
Above High School Graduate	0.310*** [0.020]	0.798*** [0.054]
AFQT	-0.001*** [0.000]	-0.002*** [0.001]
1 st Class PFT Score	0.186*** [0.019]	0.510*** [0.054]
2 nd Class PFT Score	0.082*** [0.021]	0.215*** [0.056]
Pros	0.005 [0.004]	0.013 [0.011]
Cons	-0.005 [0.004]	-0.014 [0.011]
Waiver	-0.029** [0.013]	-0.077** [0.035]
E3	-0.234*** [0.025]	-0.650*** [0.074]
E4	-0.723*** [0.017]	-2.241*** [0.078]
E5	0.355*** [0.048]	0.924*** [0.141]

VARIABLES	MARGINAL EFFECTS	PROBIT COEFFICIENTS
Combat Unit	0.038*** [0.010]	0.100*** [0.027]
Mid Atlantic	0.017 [0.024]	0.045 [0.062]
Midwest East	0.040* [0.023]	0.106* [0.061]
Midwest West	-0.072*** [0.027]	-0.199*** [0.077]
South Atlantic	-0.017 [0.022]	-0.044 [0.060]
South East	0.047* [0.027]	0.122* [0.070]
South East Central	-0.009 [0.023]	-0.024 [0.062]
West Mountain	0.026 [0.028]	0.068 [0.073]
West Pacific	0.044* [0.024]	0.114* [0.063]
Unemployment Rate	-0.038*** [0.003]	-0.100*** [0.007]
FY03	-0.196*** [0.013]	-0.573*** [0.045]
FY04	-0.183*** [0.015]	-0.531*** [0.049]
FY05	-0.157*** [0.016]	-0.449*** [0.050]
FY06	-0.167*** [0.016]	-0.479*** [0.050]
FY07	-0.166*** [0.015]	-0.475*** [0.048]
FY08	-0.124*** [0.016]	-0.347*** [0.047]
Observations	16,420	
Pseudo R2	42%	
Standard errors in brackets *** p<0.01, ** p<0.05, *p<0.1		

APPENDIX C. RESULTS OF THE OFFICERS MODEL

VARIABLES	MARGINAL EFFECTS	PROBIT COEFFICIENTS
Independent Variable		
Attrition		
Dependent Variables		
Female	0.038 [0.036]	0.131 [0.131]
White	0.039 [0.029]	0.124 [0.088]
Married	-0.363*** [0.024]	-1.319*** [0.100]
Divorced	-0.280*** [0.046]	-0.771*** [0.117]
Dependent	0.320*** [0.036]	0.952*** [0.103]
Age	-0.011*** [0.002]	-0.035*** [0.007]
Above High School Graduate	0.179*** [0.051]	0.513*** [0.136]
1 st Class PFT Score	-0.109*** [0.020]	-0.407*** [0.083]
W2	-0.825*** [0.011]	-5.87 [82.572]
W3	-0.828*** [0.011]	-6.911 [82.572]
W4	-0.817*** [0.011]	-6.55 [82.572]
W5	-0.786*** [0.011]	-6.346 [82.572]
O2	-0.881*** [0.010]	-6.239 [82.572]
O3	-0.995*** [0.002]	-5.301 [82.572]
O4	-0.986*** [0.004]	-6.041 [82.572]
O5	-0.979*** [0.005]	-6.766 [82.572]

VARIABLES	MARGINAL EFFECTS	PROBIT COEFFICIENTS
O6	-0.907*** [0.010]	-6.841 [82.572]
Combat Unit	-0.038** [0.019]	-0.123** [0.062]
Aviation Unit	0.058** [0.023]	0.200** [0.082]
Mid Atlantic	-0.026 [0.038]	-0.082 [0.118]
Midwest East	-0.013 [0.038]	-0.042 [0.120]
Midwest West	-0.032 [0.047]	-0.1 [0.144]
South Atlantic	-0.022 [0.036]	-0.071 [0.113]
South East	-0.06 [0.056]	-0.184 [0.164]
South East Central	-0.033 [0.040]	-0.104 [0.124]
West Mountain	-0.013 [0.046]	-0.043 [0.145]
West Pacific	-0.021 [0.039]	-0.068 [0.122]
Unemployment Rate	-0.003 [0.005]	-0.011 [0.017]
FY03	-0.165*** [0.053]	-0.473*** [0.139]
FY04	-0.225*** [0.051]	-0.629*** [0.129]
FY05	-0.344*** [0.057]	-0.929*** [0.145]
FY06	-0.465*** [0.055]	-1.253*** [0.155]
FY07	-0.385*** [0.050]	-1.037*** [0.130]
FY08	-0.574*** [0.036]	-1.593*** [0.124]
FY09	-0.514*** [0.038]	-1.399*** [0.116]
FY10	-0.646*** [0.027]	-1.860*** [0.113]

VARIABLES	MARGINAL EFFECTS	PROBIT COEFFICIENTS
Observations	4,014	
Pseudo R2	40%	
Standard errors in brackets *** p<0.01, ** p<0.05, *p<0.1		

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